PLACE IT TO-DAY

MARQUETTE
HIGH EARLY STRENGTH
PORTLAND CEMENT

USE IT TO-MORROW

MARQUETTE
HIGH EARLY STRENGTH
PORTLAND CEMENT
A USER'S MANUAL

FOR 24-HOUR CONCRETE

MARQUETTE

HIGH EARLY STRENGTH

PORTLAND CEMENT

PREFACE

FOR many years after the invention of portland cement in 1824, and even after the building of the first mill in the United States in 1872, many builders continued to use natural cements. This may be attributed principally to two causes: First, to the natural reluctance in those days to change from accepted methods and customs, when people were skeptical of new ideas; and second, to the slower methods of disseminating such information, or in educating the public and the builders to the superior advantages of portland cement.

Since its introduction in this country, the quality of portland cement has been steadily improved, due to refinements in manufacturing methods which assure greater purity and more uniform quality.

Marquette High Early Strength Portland Cement is a further scientific advancement in the manufacture of portland cement. Its qualities and advantages have been thoroughly tried and proven. We predict that its further use and acceptance will affect building and construction practices as greatly as did the transition from natural cement to portland cement.

The advantages and economies in the use of Marquette High Early Strength Portland Cement will be readily apparent to any one who will study the subject and apply it to his own particular construction problems.

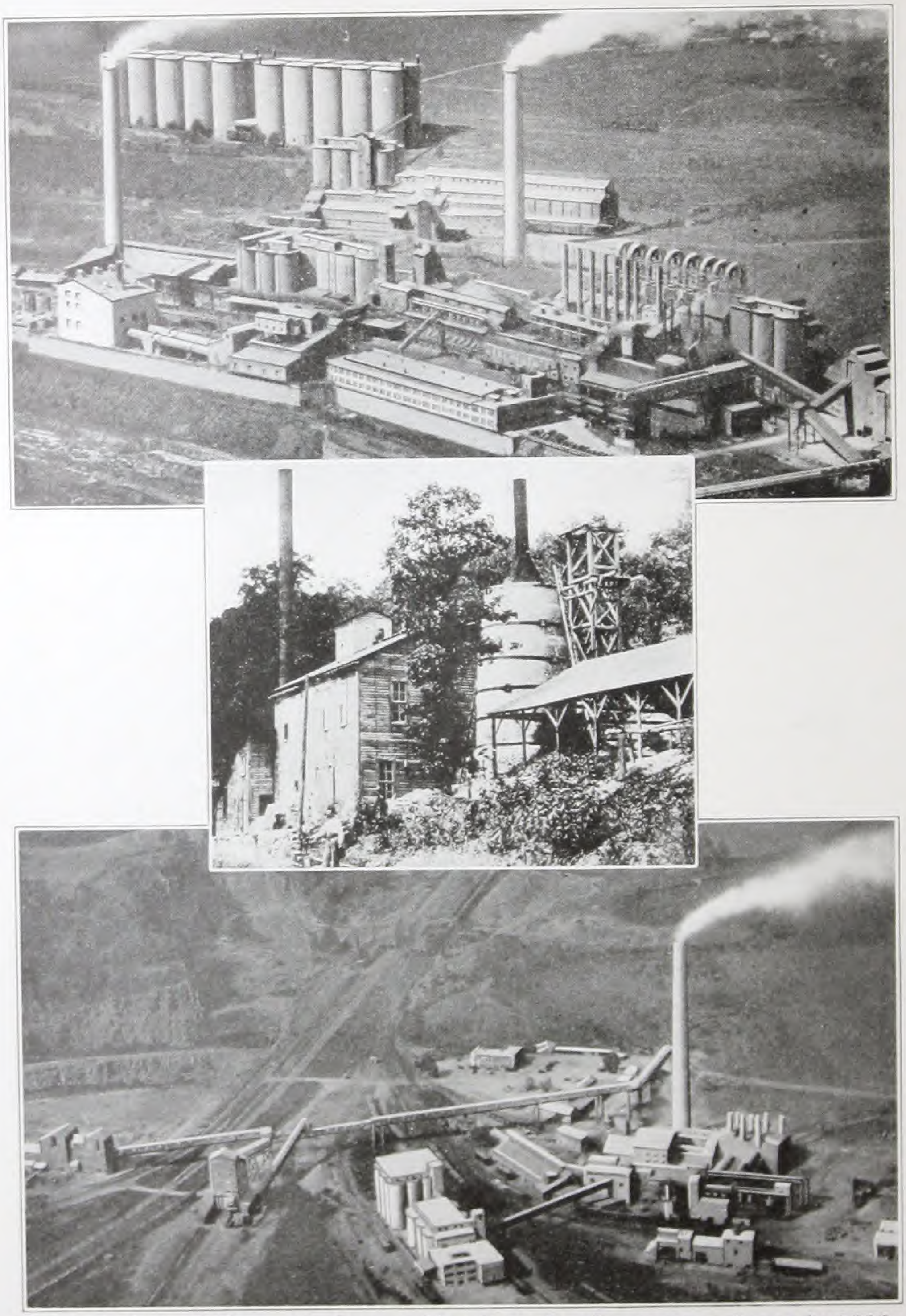
This booklet explains the purposes and uses of Marquette High Early Strength Portland Cement under various classifications and from different viewpoints. These classifications are treated in separate chapters for the reader's convenience, and, since many of the basic advantages in the use of this cement are applicable to all, a certain amount of repetition has been found unavoidable.

MARQUETTE CEMENT MANUFACTURING COMPANY

Marquette Building
CHICAGO

Union Planters Bank Building
MEMPHIS

TABLE OF CONTENTS



Original plant of Marquette Cement Manufacturing Company as it was in 1898, and the modern up to date plants of today at La Salle, Ill., above, and Cape Girardeau, Mo., below.

The PURPOSES of

Marquette HIGH EARLY STRENGTH Portland Cement

EVER since the Marquette Cement Manufacturing Company was founded in 1898, its plant facilities, manufacturing methods and products have constantly been improved and kept ahead of engineering developments and the demand for new and improved products. Marquette Cement has always been manufactured to exceed the Standard Specifications and Tests for Portland Cement prescribed by the United States Government and American Society for Testing Materials.

These specifications not only control the chemical composition and certain physical characteristics of the finished product, but also require that the cement produce certain strength at given periods. Such test standards predetermine that concrete made with a given cement will be of adequate strength to meet the requirements of the concrete structural design, when the cement and satisfactory aggregates and water are correctly proportioned and mixed to form a concrete that is afterwards properly cured.

In addition to this it has been found necessary and economically desirable in countless situations to secure this "adequate" strength more rapidly than formerly, and thus reduce the delay and inconvenience caused by waiting for ordinary concrete to harden sufficiently to be usable.

As always, Marquette Cement Manufacturing Company was among the first to recognize this need and it was a pioneer in the field of High Early Strength cements. The American Society for Testing Materials has recognized the demand and necessity for such a cement and a Standard Specification for High Early Strength Portland Cement has been adopted.

Marquette High Early Strength Portland Cement was made primarily to meet this requirement for a cement that will produce a strength in 24 hours or less, equivalent to the 7-day strength requirement for regular portland cement.

All of these specifications have been made in the interest of public safety, and have satisfactorily answered the purpose of most concrete construction work in the past, where the strength of the concrete has been the determining factor.

In late years, however, increasing consideration is being given in the design of concrete mixtures to the importance of the factors of

workability and density and their relation to the durability of the resultant concrete, by increasing its ability to resist the deteriorating effects of exposure to water, frost, organic acids, alkalis and gasses.

Marquette High Early Strength Portland Cement has also been developed to meet *these* requirements, so that it not only makes a 24-hour Concrete that may be placed TODAY and used TOMORROW, but also, because of its properties as a higher quality cement, produces a more plastic and denser, hence more durable and stronger concrete.

As a result of this, and because of the fact that Marquette High Early Strength Portland Cement so greatly surpasses the Standard Specifications, its use will result in economies both in time saved for the Owner in the earlier completion of the work (which is being recognized by leading Architects and Engineers) and in cost saving for the Contractor by expediting construction and by the easier handling of the concrete due to its greater workability.

Marquette High Early Strength concrete used on this busy Chicago intersection permitted removal of dangerous barricades in hours instead of days.

DESCRIPTION of Marquette HIGH EARLY STRENGTH Portland Cement

MARQUETTE High Early Strength Portland Cement is an improved portland cement manufactured in the same general manner as Marquette Cement. The various stages in the manufacturing processes however are more highly refined, producing a product of greater effective fineness.

All strengths of all portland cements are attained by the chemical combination of the cement with water. High early strength is attained by speeding up this chemical combination of cement with water.

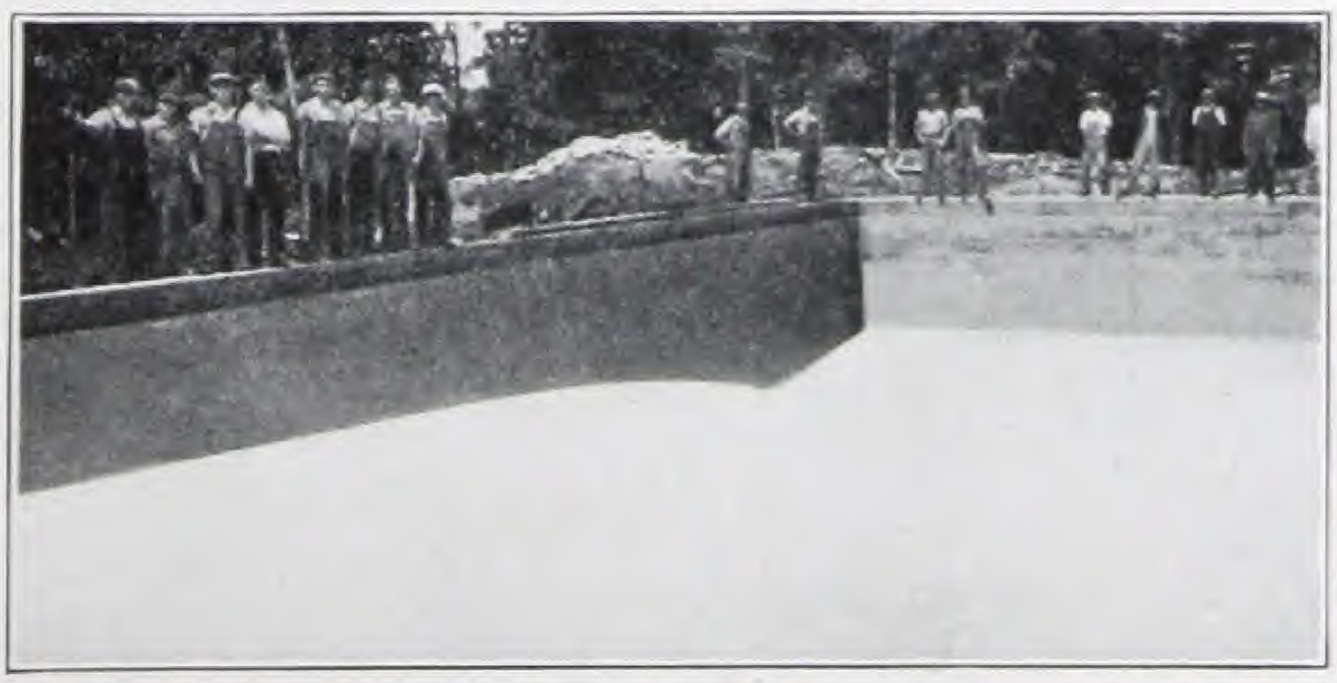
This may be done in three ways:

1. By having the cement finely and effectively ground.
2. By raising the percentage of lime in the basic composition.
3. By adding an accelerating admixture.

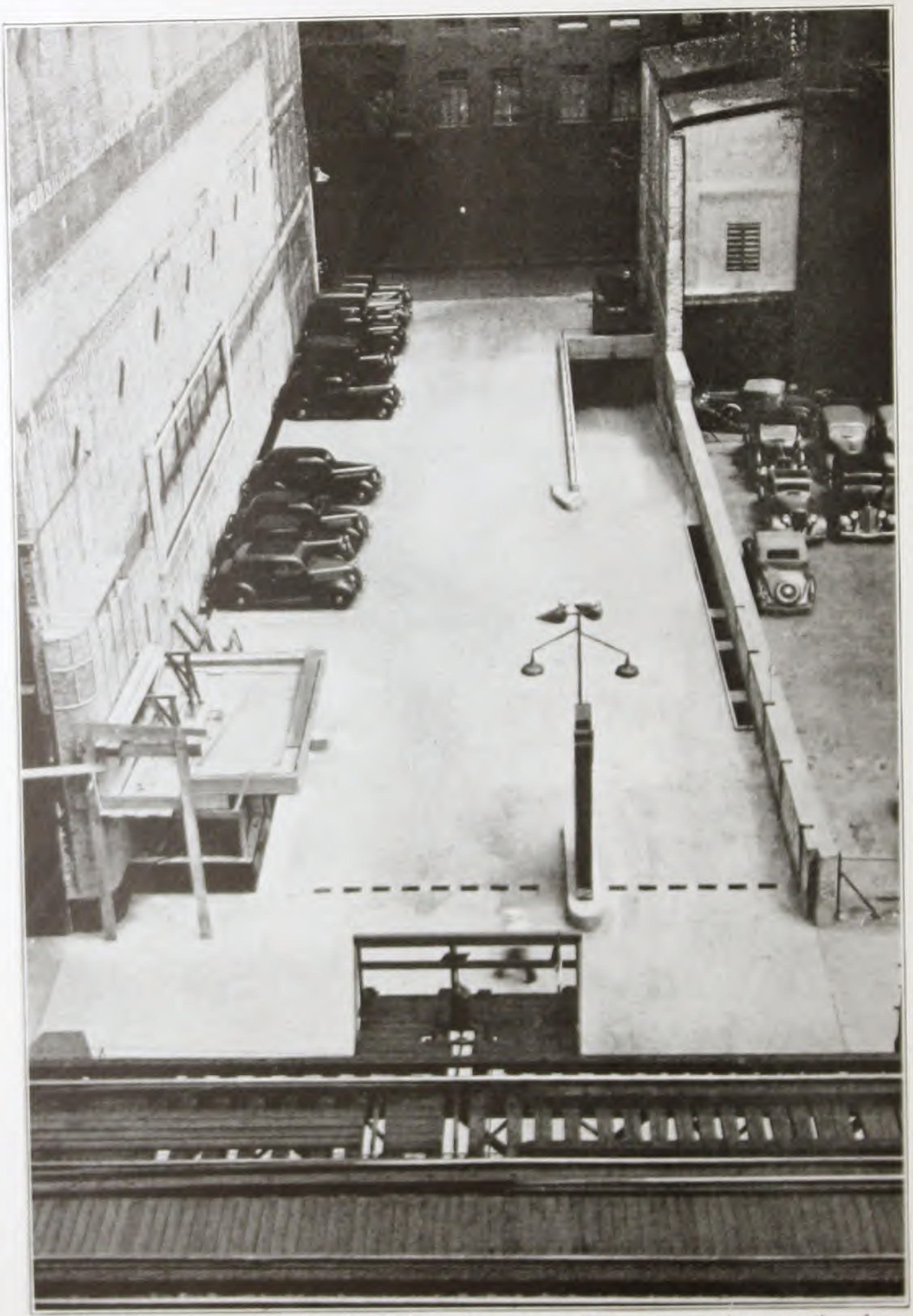
Marquette High Early Strength Portland Cement is produced by the first method as it has been demonstrated that this is the best method of manufacturing a high early strength cement that will surely and uniformly produce the desired results without departing from the well recognized relationships of chemical compounds in portland cements.

Fineness of Marquette High Early Strength Portland Cement is measured by determining the surface area of the fine particles. The greater the area of these particles coming in contact with water, the more quickly will the cement and water combine to produce high early strength and the more completely will they combine to develop higher later and ultimate strengths.

Marquette High Early Strength Portland Cement greatly exceeds the Standard Specifications for High Early Strength Portland Cement of the American Society for Testing Materials.



The extreme density of Marquette High Early Strength concrete insures the watertightness of this pool built for the Methodist Assembly at Arcadia, Mo.



Parking lot pavement of the R. G. Lydy Company, Chicago, put into service days ahead of the time possible with regular cement by using Marquette High Early Strength Portland Cement.

CHARACTERISTICS of Marquette HIGH EARLY STRENGTH Portland Cement

THE selection and proportioning of the materials in the composition of Marquette High Early Strength Portland Cement and the effective fineness to which it is ground, produce the following results:

1. ***High Early Strengths and Higher Later Strengths.***

   Marquette High Early Strength Portland Cement produces concrete of sufficient strength under normal conditions to permit its use in 24 hours or less.

   This high early strength is not secured at the expense of later strengths. On the contrary, concrete made with Marquette High Early Strength Portland Cement continues to increase in strength at relatively the same rate as regular portland cement and shows greater strengths at all times.

   During mixing and placing Marquette High Early Strength concrete remains workable and plastic about the same length of time as regular portland cement concrete.

2. ***Greater Density.***

   Because this cement is more efficient it will produce a denser concrete than a like volume of ordinary portland cement, other conditions being equal. This cement requires less water to obtain a given consistency than regular portland cement, thereby reducing the amount of water to evaporate and leave air voids, consequently resulting in less porosity and greater density. Dense concrete is impermeable, more watertight, and more durable.

3. ***Greater Workability.***

   The third important characteristic is its extreme plasticity. This cement produces a smoother mix, which not only trowels and finishes more easily, but also produces a more workable and easier flowing concrete, mortar or stucco. This is of particular value to the contractor who is confronted with any unusual problems of handling or placing.

Central Avenue in Chicago was paved with Marquette High Early Strength Concrete and was put back into service in record time with a minimum of inconvenience to the Public.

WHY and HOW should Marquette HIGH EARLY STRENGTH Portland Cement be used?

WHY?

1. To obtain earlier use of structure.
2. To secure quicker re-use of forms.
3. To reduce cost of curing.
4. To make easier handling concrete.
5. To obtain earlier returns on the investment.
6. To produce more durable concrete.
7. To meet emergencies.
8. To reduce freezing hazards in winter.

all of which

SAVE TIME AND MONEY

HOW?

Marquette High Early Strength Portland Cement requires no special treatment on the job. It may be used the same as Marquette Cement.

The Seal Pond at the Brookfield Zoo near Chicago had to have concrete that was watertight and plastic as well as high early strength. The use of Marquette High Early Strength Portland Cement assured all of these.

WHAT

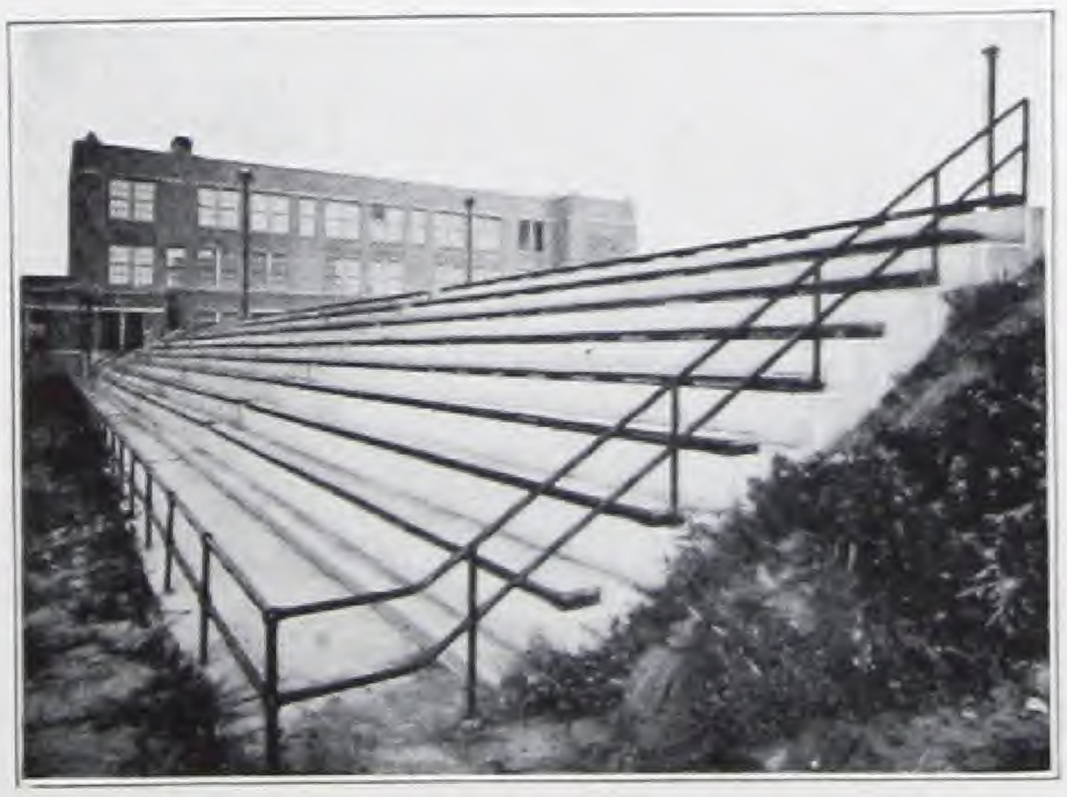
Marquette HIGH EARLY STRENGTH Portland Cement

means to the . . . . . PUBLIC

THE value of high early strength concrete for the safety and convenience of the public may be readily demonstrated. A striking example would be the repaving of a fire station driveway or floor, which, with the use of regular portland cement would be closed for a week or more. With Marquette High Early Strength Portland cement the fire department can be in service again in twenty-four hours or less.

When paving a street in a business section, the merchants as well as the public would certainly benefit if each block could be opened to traffic the day after it was completed. Paving between street car tracks, at railroad crossings and streets being repaired can all be opened for earlier use, causing considerably less inconvenience and danger to the public by the quicker removal of barricades. Miles of detours can likewise be eliminated by opening Marquette High Early Strength concrete to use in twenty-four hours or less instead of diverting traffic for a week or more.

Furthermore, all streets intersecting another street under construction are blocked and their use curtailed unless the intersections are promptly opened to traffic. Surely the use of Marquette High Early Strength Portland Cement will be amply repaid by opening cross streets promptly with a consequent reduction in detours, barricades, and general inconvenience and danger to the public.



When concrete work has to be ready in emergencies, Marquette High Early Strength Portland Cement is the answer, as it was for these bleachers at the Hancock High School in St. Louis County.

Consider the great importance of putting back into use streets and intersections, and of eliminating obstructions to unrestricted flow of traffic, in a period of hours instead of days especially as it affects the efficient operation of such vital public services as policing and fire fighting.

Aside from convenience and safety, if there is any truth in the statement that "time means money," an appreciable saving may be secured by the earlier use of Marquette High Early Strength concrete in various kinds of public works.

In public works the question of durability is important. This may range from more watertightness or resistance to freezing and thawing, to special conditions where a high degree of impermeability is necessary to withstand the deteriorating influence of sewage or contaminated waters.

Public works construction is a matter of public interest. Many officials are aware of the advantages of expediting public improvements and have used Marquette High Early Strength Portland Cement not only for greater convenience and safety, but also to more effectively and economically build durability into concrete.

This grade crossing on the Northwestern Railroad in Batavia, Illinois, was opened to traffic in a day's time by the use of Marquette High Early Strength Portland Cement.

To assure resisting the abrasive action of heavy steel tired trucks, this floor in the Aurora Metal Cabinet Company plant was finished with Marquette High Early Strength Portland Cement.

Concrete pavement in the storage yard of the Chicago Pump Company had to be in service quickly and the finished job has to stand up under the severest punishment. Marquette High Early Strength concrete met these extreme requirements.

WHAT

Marquette HIGH EARLY STRENGTH Portland Cement means to the . . . . . OWNER

WHETHER the Owner of a concrete project be a State, Municipality, School, Park, or Sanitary Commission, Railroad, Utility, Manufacturer or Individual Property Owner, each will be concerned with how the use of Marquette High Early Strength Portland Cement will bring about a required or desired result (not obtainable with regular portland cement) in many situations, several of which follow:

(a) In emergencies where a project must be available for use at the earliest possible time.

(b) In any situation where conditions require maximum density, impermeability, and watertightness.

(c) In improvements or repairs where the time element is important because of public convenience, safety or interference with other work.

(d) In earlier completion of a project which puts it into productive use and secures earlier earnings on the investment.

Many examples can be cited to show the value and advantages of Marquette High Early Strength Portland Cement but we believe its economic value to the Owner may be more convincingly demonstrated by showing what it cost NOT to use it in a specific instance.

Regular portland cement was used during the remodeling of a gas station, where service was maintained during construction, which included paving of drive-ways and reconstruction of the wash rack, oil changing and greasing facilities. The drives were paved one half at a time and each section was closed to traffic for seven days. During the fourteen day period, when one or the other of the drives were closed to traffic, the gasoline sales dropped 60%, equivalent to a daily loss of $60.00, or a total of $840.00 in gasoline sales volume.

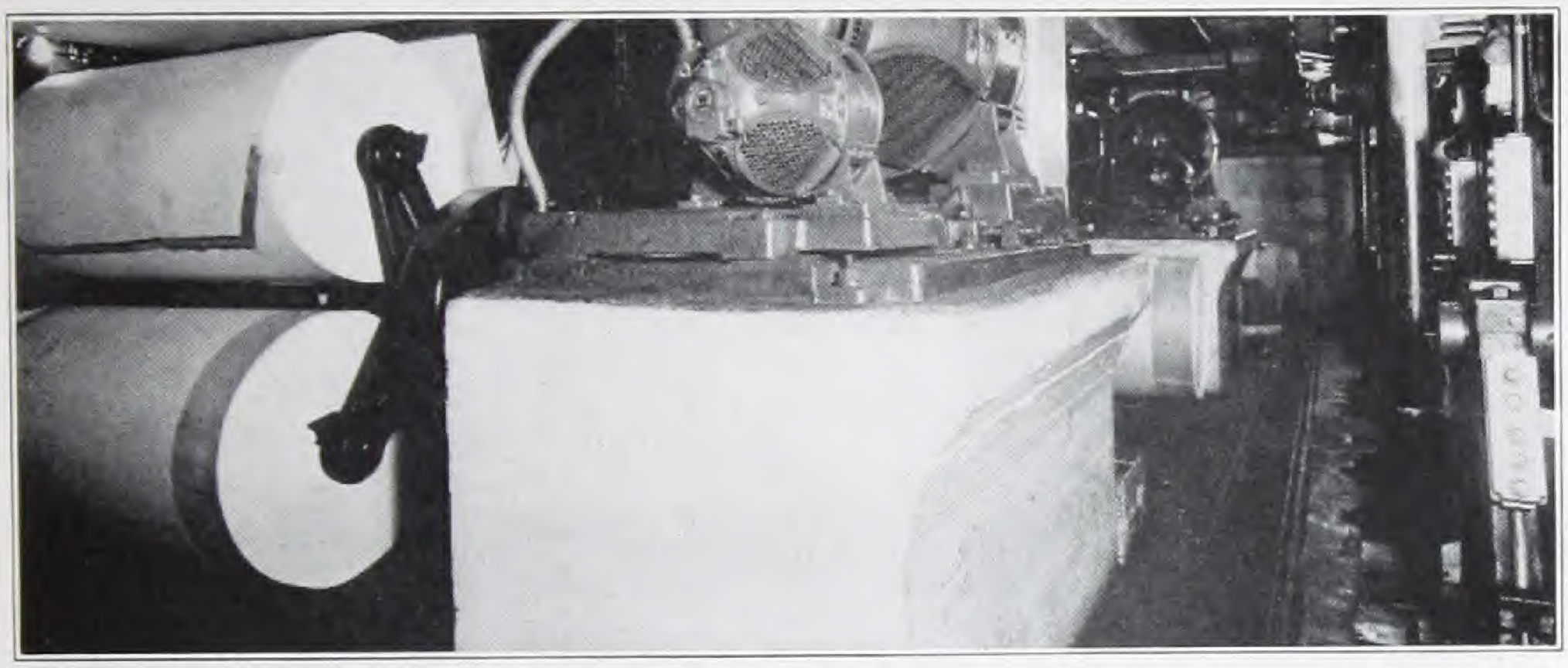
Production schedules of "the beer that made Milwaukee famous" could not be long interrupted at the Schlitz Brewery. Marquette High Early Strength concrete floors were in service 24-Hours after placing.

The oil changing, greasing, washing, and service department of the station had to be closed for a period of seven days, and the sales loss amounted to $33.33 per day, or a total of $233.31 for this department. This meant a total loss of $1,073.31 in sales volume for the entire station based on average monthly sales.

Had Marquette High Early Strength Portland Cement been used, each section of the pavement could have been opened in one day, causing interference with gasoline sales for only two days, or a loss of only $120.00 in sales. The balance of the station could have been opened in one day, reducing the sales loss to $33.33, or a total loss of only $153.33, instead of $1,073.31.

The job required 110 barrels of cement, and the additional cost for Marquette High Early Strength Portland Cement in this instance would have been only a trifle over $50.00. By its use, twelve days could have been saved in gasoline sales and six days in service department sales.

Unlooked for freezing weather threatened to interfere with the scheduled opening of this Service Station in Fulton, Kentucky. At the owner's request, Marquette High Early Strength Portland Cement was used and the station was ready for business on time, despite the weather.



Printing the news cannot be delayed and because delays are eliminated with Marquette High Early Strength concrete, it was used for this motor foundation by the Chicago Daily Times

This difference between the actual sales loss of $1,073.31 and the sales loss of only $153.33 if Marquette High Early Strength Portland Cement had been used, would have been $919.98 as shown below.

Actual Loss of Sales Volume:

14 days of Gas Sales @ $60.00 per day	$840.00	
7 days of Oil, etc., @ $33.33 per day	233.31	
Total		$1,073.31

Loss in Sales Volume if Marquette High Early Strength Portland Cement were used:

2 days of Gas Sales @ $60.00 per day	$120.00	
1 day of Oil, etc., @ $33.33 per day	33.33	
Total		$ 153.33
Difference which could have been saved		$ 919.98

This does not take into account the intangible loss of good will. The saving could have been made by the expenditure of a sum which would have been equivalent to less than ½ of 1% of the total contract cost.

The amount of time which can be saved on any job can be predetermined, and the owner can easily decide the value of this time, so that the practical value of using Marquette High Early Strength Portland Cement can be evaluated readily by the owner.

The above example proves the economy of Marquette High Early Strength Portland Cement in one instance which can be multiplied almost indefinitely; but in addition to economy the owner should take into consideration the greater durability of concrete made with Marquette High Early Strength Portland Cement due to its increased density and impermeability.

1. General view of substation being prepared for moving.

2. View underneath the building showing rotary foundation and lally column foundation on jacks.

3. Building additional floor support by placing a layer of concrete underneath.

4. Interior view showing large rotary converters.

5. View under the rotary foundation showing undermining and shoring process.

6. View under building showing east wall on direct drums while supporting slab was poured.

7. Building resting on jacks which are embedded in concrete above and below.

8. Building being transferred from drums to shoe beams.

When this power station in Chicago had to be moved 17 feet to permit street widening, Marquette High Early Strength Portland Cement was the material selected for underpinning and for the concrete mat over which this FIVE MILLION POUND load was moved to the new location within 48 hours after placing.

The Gooder-Henrichsen Company, Inc., Contractors, reported "Your High Early Strength Cement left nothing to be desired and entirely fulfilled our requirements, allowing us to reduce our time from an eighty day schedule, carrying a $100.00 a day penalty, to forty days."

WHAT

Marquette HIGH EARLY STRENGTH Portland Cement means to the . . . CONTRACTOR

On Large Monolithic Structures

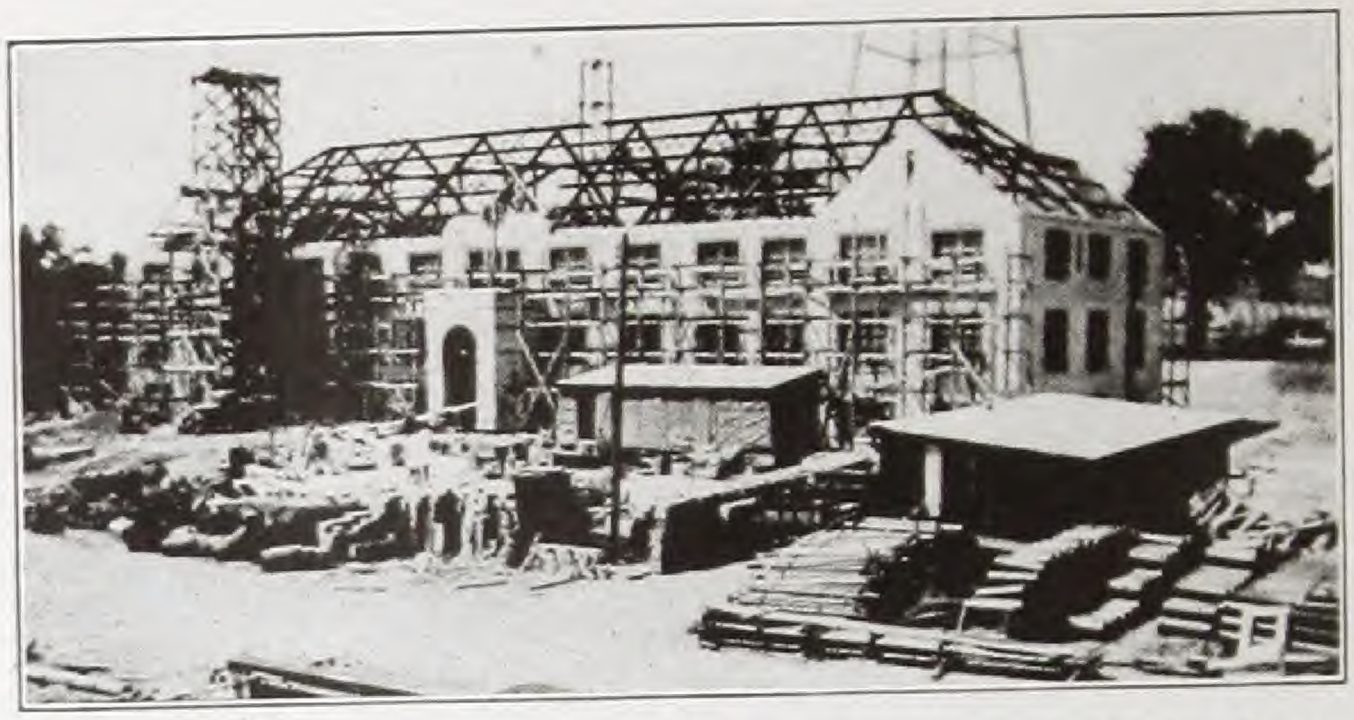
TO the contractor engaged in the building of Dams, Railroads, Subways, Tunnels, Sewers and Bridges, Marquette High Early Strength Portland Cement will appeal chiefly from the standpoint of economies.

Where large amounts of concrete are to be placed, the expense of conveying and placing this concrete, whether it be chiefly mechanical or labor expense, looms large in construction costs. While the gradation and proportioning of the aggregates largely determines the workability of any concrete mixture, it will be found that Marquette High Early Strength Portland Cement will make a harsh mixture more workable, and will increase the flowability or ease of handling of any combination of cement and aggregate over regular portland cement. This may mean that concreting towers will not have to be built so high, or that chutes will cover a larger area, or that in many other ways the concrete can be conveyed more cheaply, or it may mean lower labor costs in placing because one man can handle more concrete.

In some phases of large construction work it will be found that the high early strength feature can be used to decrease costs by making it possible to strip forms and re-use them in 1/7th of the time ordinarily required. This early strength will also make it possible to save money in the lesser time required for curing the concrete, which is particularly true in freezing weather.

On Buildings

While the foregoing reasons may apply equally to the building contractor, the greater workability of Marquette High Early Strength concrete is of particular interest because of the difficulties often



To insure rapid construction progress on this State institution building at Algoa Farms, Missouri, Marquette High Early Strength Portland Cement was used for all structural members.

encountered in properly placing reinforced concrete in beams, columns and other members, without segregation and the formation of gravel or stone pockets. Marquette High Early Strength concrete flows into place and stays in place.

In certain types of concrete building construction, for example in mills or warehouses, when concrete can be placed TODAY and used TOMORROW, a great saving can be made in the earlier re-use of forms.

The cost of protecting concrete buildings against freezing is considerable. When the protection period can be reduced to 1/7th of the time ordinarily required with regular portland cement concrete, not only is the hazard of freezing reduced, but also the cost of protecting against it.

On Pavements

Under many special circumstances or conditions, paving contractors have found it to their advantage to use Marquette High Early Strength Portland Cement. Cases in point are the closing of gaps or the building of small stretches of pavement where considerable money is saved by being able to finish up completely and get off the job in a matter of hours instead of being forced to maintain barricades, cross-over bridges at intersections, lighting and watchman service during a period of days. Marquette High Early Strength concrete can be completed and opened to use in 24-Hours or less.

Another illustration of the advantage of the use of this cement is in connection with the desired completion of a pavement late in fall when there is danger of freezing. Since Marquette High Early Strength concrete passes the danger of freezing much more rapidly than if regular cement is used, the hazard of frozen concrete is greatly minimized and the cost of protecting against freezing is materially reduced, or perhaps entirely eliminated.

In these cases as in many others, the slight extra cost to the contractor is many times offset by the savings made in labor costs or by reduction of the risks involved.

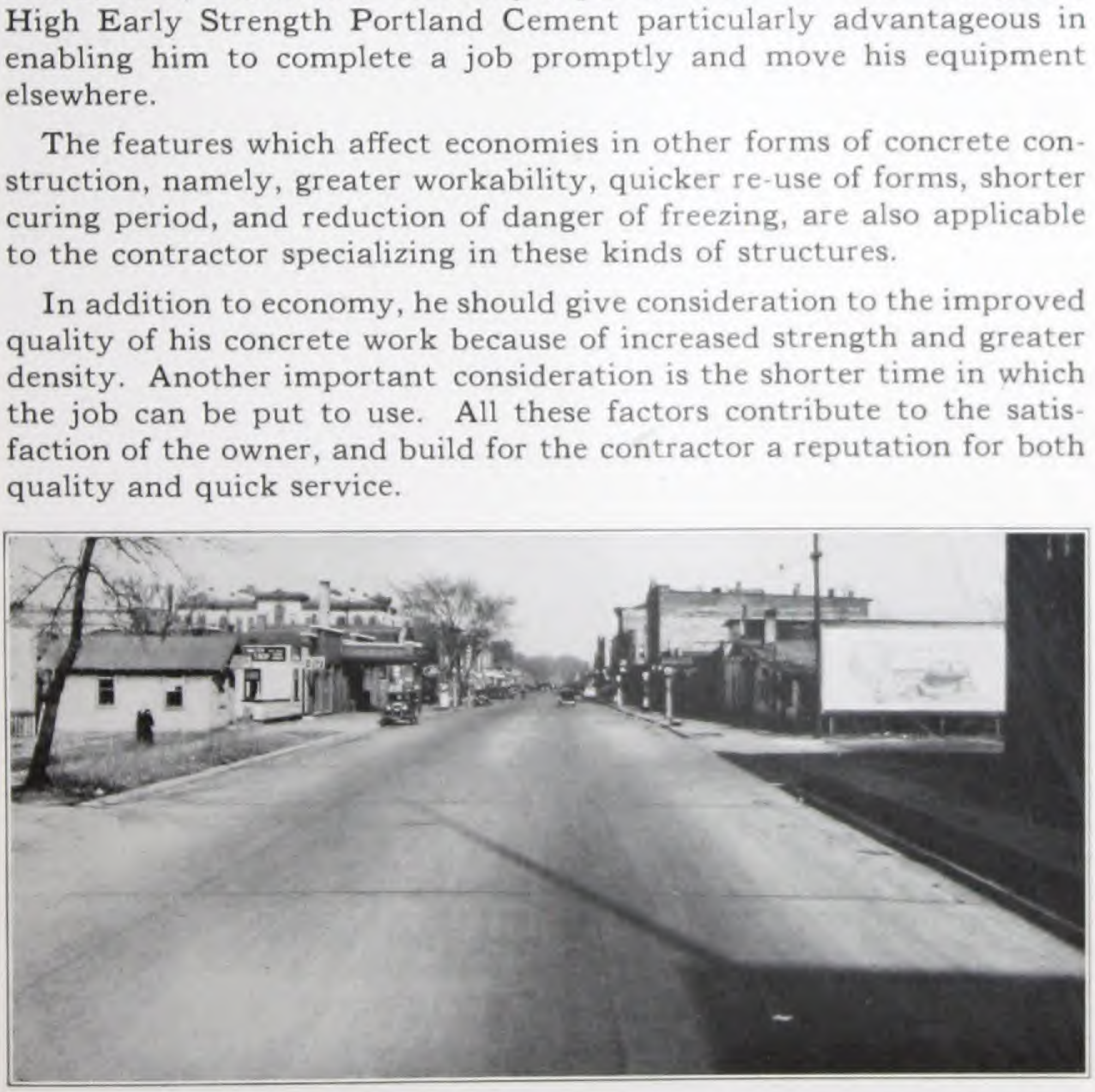
As Marquette High Early Strength Portland Cement will produce a concrete as strong in 24 HOURS as regular portland cement will produce in 7 DAYS and considerably stronger in 3 DAYS than regular portland cement in 28 DAYS, it is obviously not necessary to continue the curing and protecting of the concrete during hot and dry weather for the longer period required for regular portland cement concrete to attain required strength. This will not only mean considerably less material for covering, but also a decrease in labor cost of keeping it wet over the longer period.

On Small Structures

The contractor who specializes in smaller concrete work, such as foundations, sidewalks, driveways, pools, etc., will find Marquette High Early Strength Portland Cement particularly advantageous in enabling him to complete a job promptly and move his equipment elsewhere.

The features which affect economies in other forms of concrete construction, namely, greater workability, quicker re-use of forms, shorter curing period, and reduction of danger of freezing, are also applicable to the contractor specializing in these kinds of structures.

In addition to economy, he should give consideration to the improved quality of his concrete work because of increased strength and greater density. Another important consideration is the shorter time in which the job can be put to use. All these factors contribute to the satisfaction of the owner, and build for the contractor a reputation for both quality and quick service.



It isn't necessary to tie up men, money, and equipment on a small job. This short gap at Ottawa, Illinois, was paved and opened to traffic in LESS than 24-Hours with Marquette High Early Strength Portland Cement.

Time Saved for All Contractors

Whether the job be one requiring years to complete or one that can be finished in a day, the time element often means the difference between profit and loss. Rapid progress on any construction enterprise is essential to success. The use of Marquette High Early Strength concrete may in various ways facilitate the progress of a job. On a large project the fact that it can be used in 24 HOURS may permit the additional use of equipment with resultant decrease in overhead.

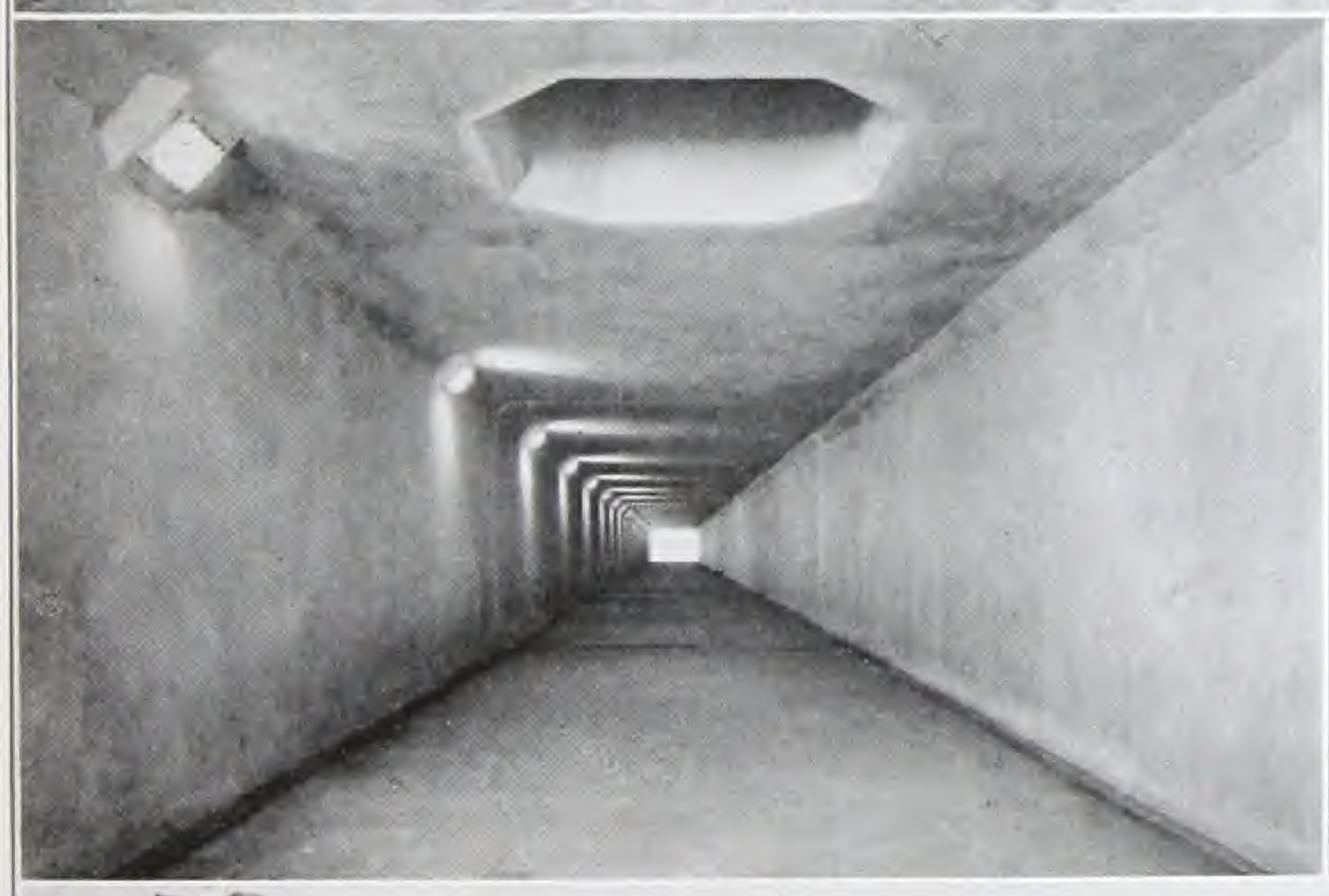
In a concrete building the work of sub-contractors may be started that much earlier and their schedules be better co-ordinated, reducing much of the confusion frequently encountered. Because of its high early strength, greater workability and the lesser time required for curing, the paving contractor can speed up his completion time, and on small structures this time element is of considerable importance.

The significance of the time element is demonstrated in the construction of the pedestrian tunnel under Michigan Avenue in Chicago. In the Spring of 1935 this work was completed with Marquette High Early Strength Portland Cement in 117 hours less than the time allowed. As there was a penalty and bonus clause in the contract amounting to $25.00 per hour, this meant a bonus of approximately $3,000.00 to the contractor, who might have incurred a penalty, if regular portland cement had been used.

This tunnel was built to insure the safety of the public in reaching the Oak Street Bathing Beach as crossing Michigan Avenue at the street level was extremely hazardous, due to automobile traffic, which, at this intersection, is probably heavier than at any other point in the City.

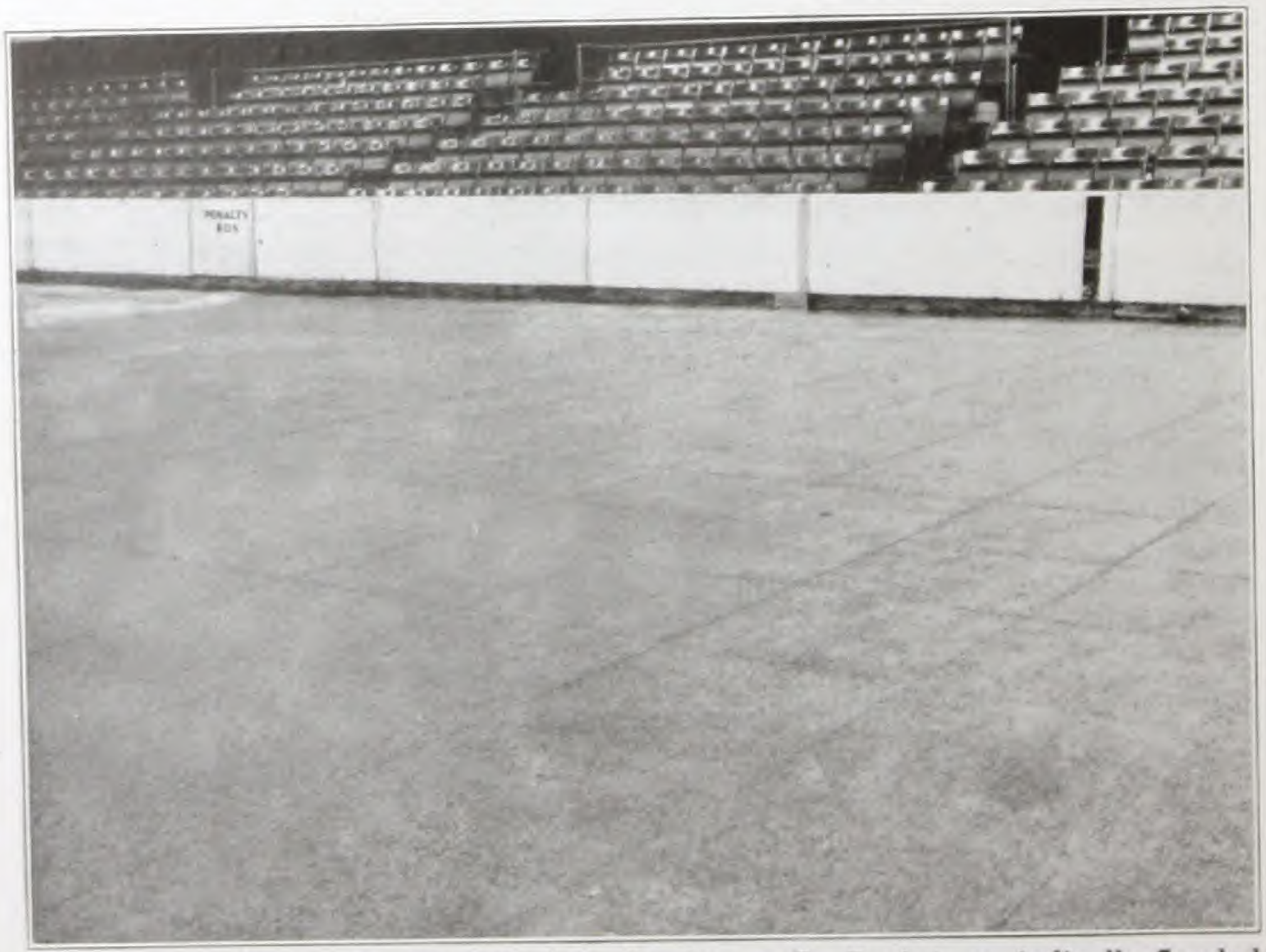
As Michigan Avenue is the main artery from downtown Chicago to the north side and the north shore suburbs, many thousands of autoists were inconvenienced for a minimum period, which meant a saving of thousands of miles of detour and thousands of hours to the motoring public.

Speed in placing this floor at Milwaukee was essential so Marquette High Early Strength Portland Cement turned over a completed job 24-Hours after work was started.



Oak Street Tunnel, Chicago, on which both time and money were saved by the contractor and for the public by using Marquette High Early Strength Portland Cement. See text opposite.

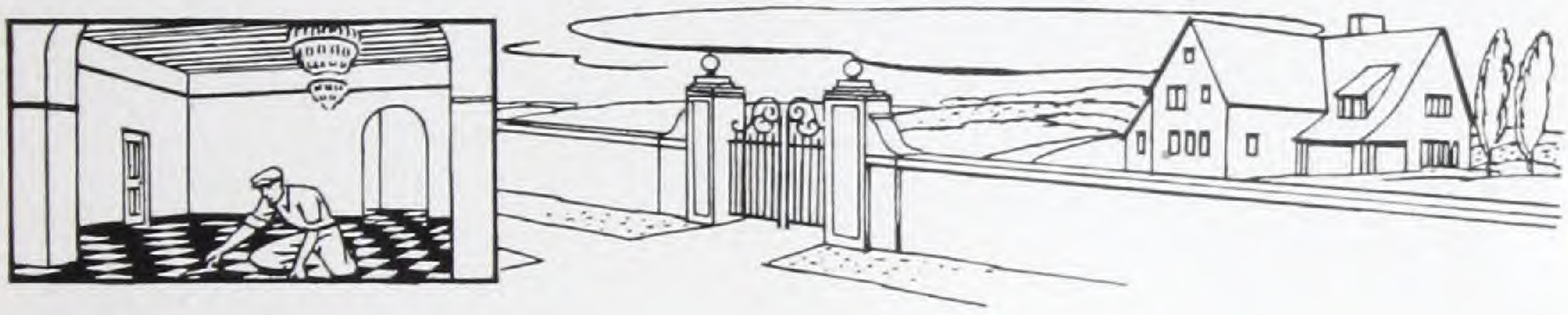
At Green Bay, Wisconsin, Marquette High Early Strength Portland Cement was used to stucco this home in winter, because its plasticity made it easier to work and its high early strength eliminated all danger of freezing after 24-Hours.



The terrazzo floor in the Municipal Auditorium at St. Paul, is periodically flooded and frozen for skating. The concrete had to be durable and watertight so Marquette High Early Strength Portland Cement was selected for the work.

WHAT

Marquette HIGH EARLY STRENGTH Portland Cement means to the . . . . . STUCCO AND TERRAZZO CONTRACTOR



THERE is probably no work in which cement is used where cohesiveness and workability are such important factors as in the application of stucco. These factors vitally affect the labor cost of the job, which because of the nature of the work constitutes a large part of the expense.

Marquette High Early Strength Portland Cement makes a *smoother* mortar or stucco which spreads with the least effort. While its extreme plasticity, compared with regular portland cement, is its chief advantage to the Plastering or Stucco Contractor, there are many occasions where its high early strength also will be found advantageous in speeding up the work. The greater density obtained with Marquette High Early Strength stucco obviously makes it more resistant to the elements and to all other deteriorating influences. It can be used and finished and combined with mineral pigments for coloring the same as any portland cement.

In terrazzo work, its greater plasticity and cohesiveness likewise makes it possible to place it with greater ease and consequent saving in time and labor. Its high early strength permits the contractor to begin grinding and polishing much sooner.

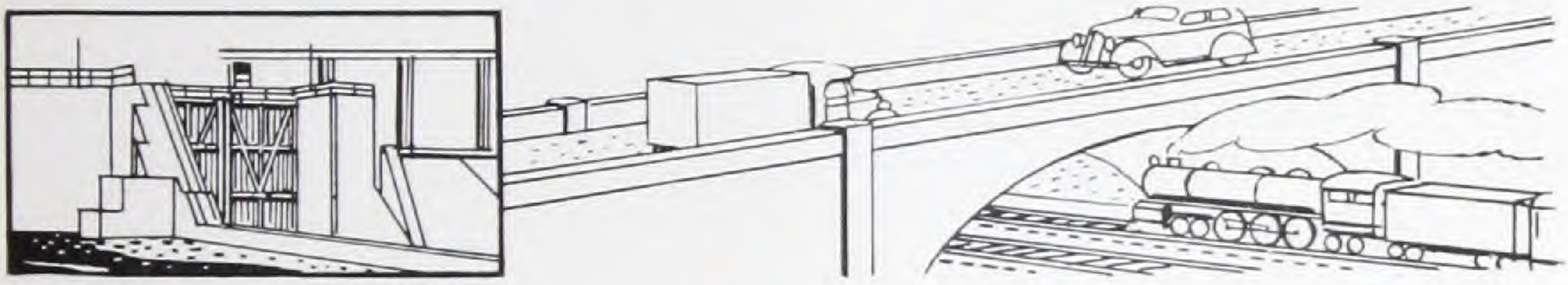
High early strength does not mean premature hardening, as during the early stages of hydration, it acts the same as regular portland cement. The greater density of Marquette High Early Strength mortar also decreases the amount of "fill-in" usually required, which again means a saving in time and labor, as well as earlier completion of the work.

Railroad terminals must be repaired and maintained with a minimum of delay and inconvenience. This passenger walk for the C.M.St.P.&P. Railroad at Milwaukee was opened for service less than EIGHT HOURS after Marquette High Early Strength concrete was placed.

Marquette High Early Strength Portland Cement was used in constructing this roof slab at the La Salle Street Station, Chicago, to minimize public inconvenience and maintain operating schedules and to secure durability.

WHAT

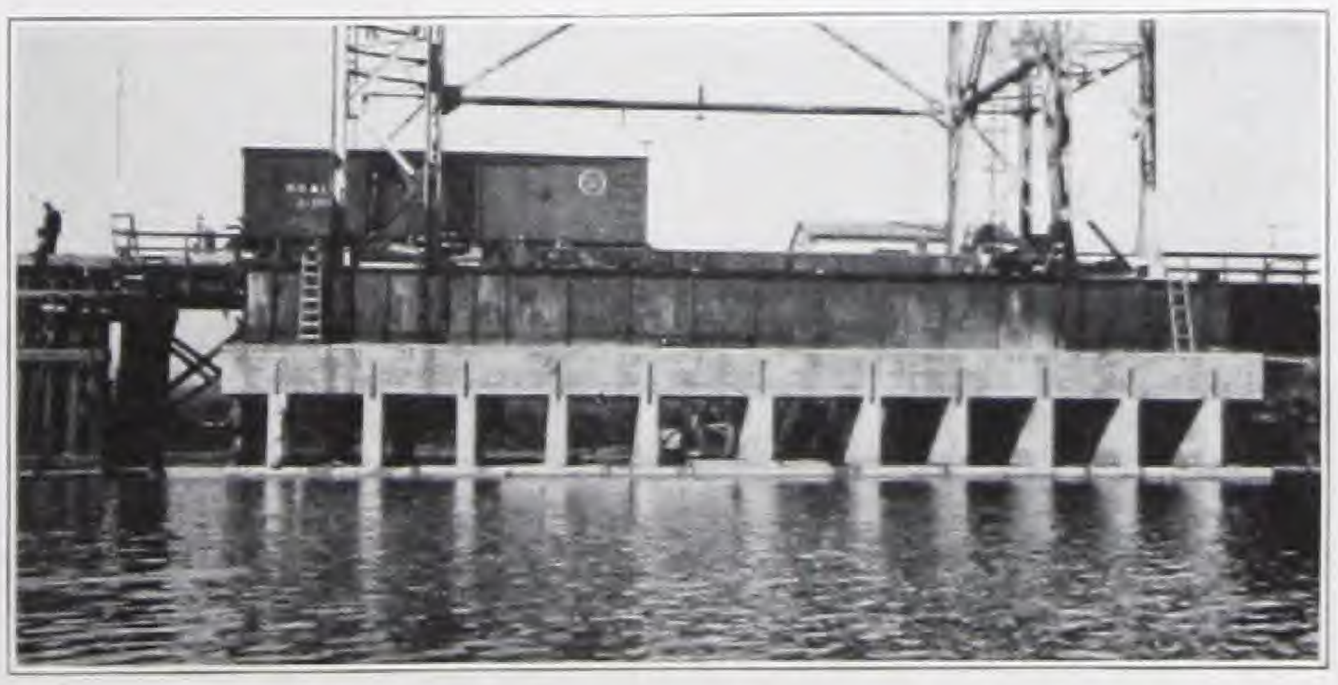
Marquette HIGH EARLY STRENGTH Portland Cement means to the . . . . . ENGINEER



On Railroad Construction

WHETHER in charge of Construction or Maintenance, the Railroad Engineer is concerned with minimum disruption of operating schedules. This requires that all work on the right-of-way be executed *on time*. With concrete that can be used 24-Hours or less after placing, there is ample assurance that such work will be finished *ahead* of normal time; or by the same token more concrete work may be scheduled for a certain period with the assurance that it will be ready for service as planned, in spite of the hazardous nature of much railroad construction.

This early strength feature, however, is not the only advantage offered to the Railroad Engineer by Marquette High Early Strength Portland Cement. Much of the concrete used by railroads is subjected to extreme conditions of exposure, varying from the chemical action of stack fumes to freezing and thawing. To combat these disintegrating forces demands concrete of maximum density. The proper design of concrete mixtures will help to accomplish this, but Marquette High Early Strength Portland Cement increases the density of any concrete mix over regular portland cement because of its effective



The underpinning of this bridge for the Missouri Pacific Railroad at Belle Chasse, Louisiana, was constructed and put into service in record time by the use of Marquette High Early Strength Portland Cement.

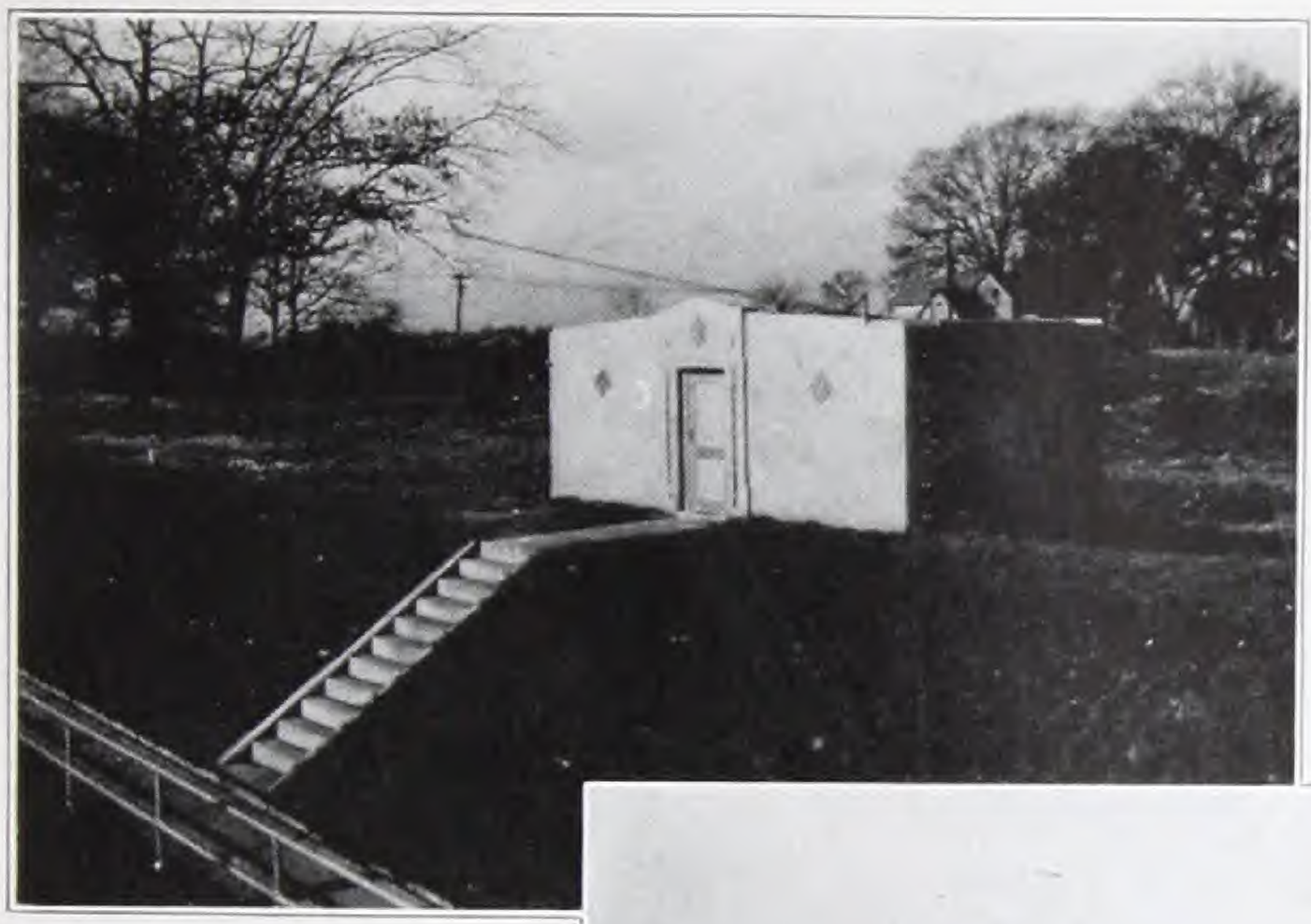
fineness and resultant plasticity so that with a properly designed mix waterproof concrete will be obtained.

On Bridge Construction

The Engineer specializing in the design and construction of Bridges will be interested in the possibilities offered by Marquette High Early Strength concrete. Its earlier strength, making possible the quicker removal of hazardous barricades and dangerous detours, means greater public convenience and safety. Its higher later and ultimate strengths, together with its greater density, insure the durability of the structure. The shorter time required for curing is also a factor in opening a project to earlier use, and in cold weather, minimizes the risk of freezing and reduces the cost of curing.

The appearance of the finished structure is greatly improved in that corners, lines and reliefs are more sharp and clean-cut because the greater worability of Marquette High Early Strength concrete causes it to flow into place much more readily and easily. It does not segregate leaving unsightly pockets when the forms are stripped, and its greater plasticity results in smoother and more pleasing finished surfaces.

This grade crossing of the C.B.&Q. Railroad on the Batavia-Kaneville Road in Illinois was back in service within 24-Hours because Marquette High Early Strength Portland Cement was used. It saved miles of detours to the motorist.



Marquette High Early Strength Portland Cement was used for this pump house and grade elimination project at the Frisco tracks, Amory, Miss., to insure dense, impermeable concrete.

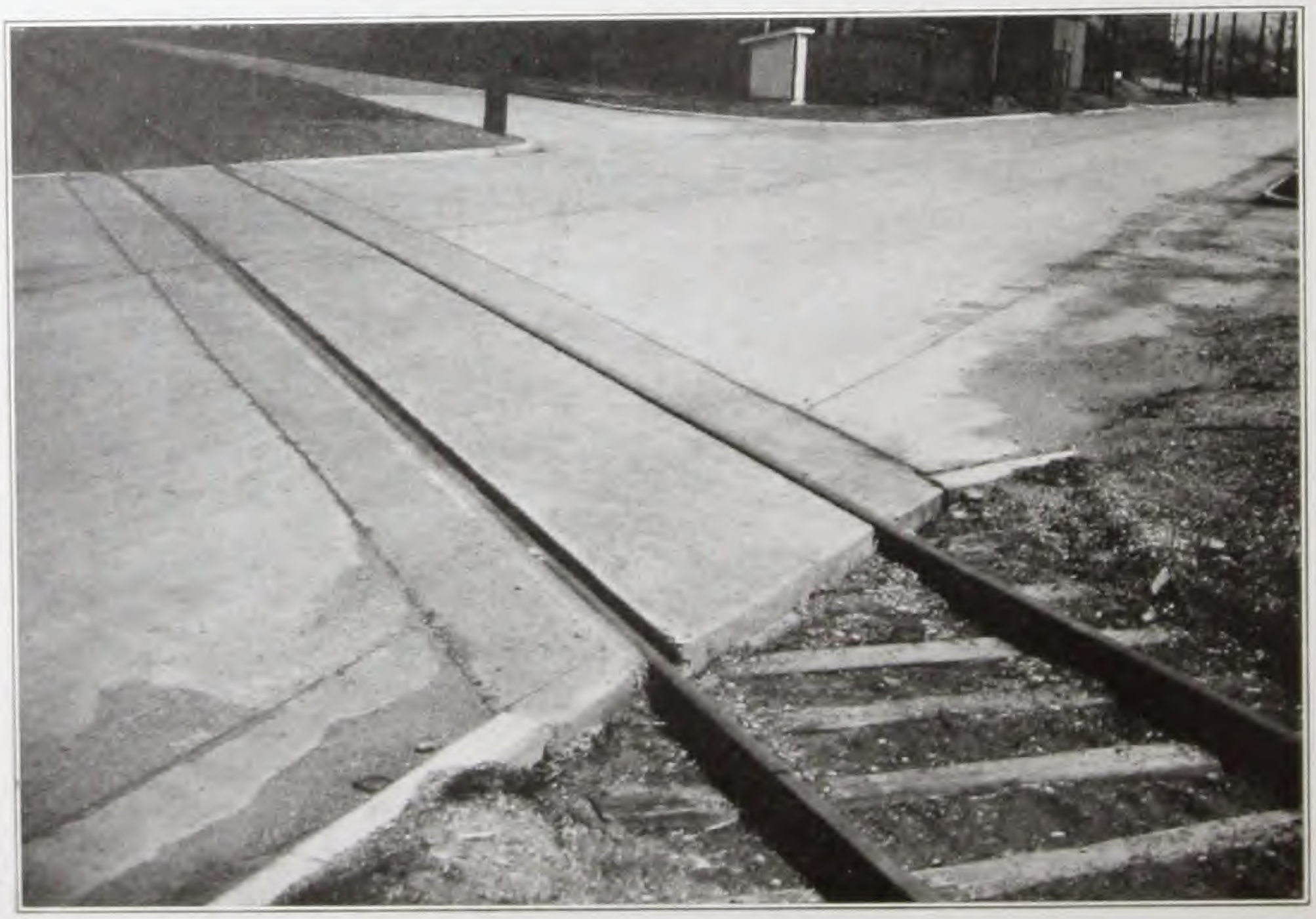
By placing a deck slab on the River Des Peres Parkway overhead crossing in St. Louis County with Marquette High Early Strength concrete, it was made ready for use by the time the substructure had attained its proper strength.

On Highway Construction and Maintenance

Because the public, and principally the motoring public, is paying for highway construction, it would seem plausible that public convenience and safety should be considered in the building of highways. The use of Marquette High Early Strength Portland Cement will permit a highway or bridge to be opened to traffic a week or so earlier than would be possible with regular portland cement, therefore the value of the time saved may be compared in advance with the cost of the saving of this time to ascertain whether conditions justify the additional expenditure.

It should also be kept in mind that an improvement or replacement which causes a detour over a low type road means that the cost of driving is more than 33⅓% greater per mile than the cost for the same distance on concrete. This additional cost is further greatly increased because detours are almost invariably two or three times longer than the road under construction.

Although it is realized that repairs to concrete highways may usually be made without closing the entire road to traffic, nevertheless the inconveniences and hazards caused by one way traffic are considerable.



Dangerous barricades, detours and inconvenience to the public were eliminated after 24-Hours by the use of Marquette High Early Strength concrete at this railroad crossing on State Road 67, in Indianapolis.

Marquette High Early Strength concrete used in re-locating Highway 12 near Hudson, Wisconsin, minimized barricade hazards and inconvenience.

The approaches to this bridge over the Tennessee River on Highway 60 in Kentucky were paved with Marquette High Early Strength concrete so the bridge could be opened to traffic within 24-Hours.

The dangers of one-way traffic during highway repairs are reduced to the minimum when Marquette High Early Strength Portland Cement is used. Barricades can be removed in less than 1/7th of the time ordinarily required.

Automobile accidents and fatalities are increasing, and, while barricading one lane of a pavement for repairs is not a principal contributing cause, nevertheless such conditions do cause many accidents and should be reduced to the absolute minimum. This reduction can be greatly aided by the use of Marquette High Early Strength Portland Cement. In fact, the entire elimination of barricades at night, when most of such accidents do occur, is not impossible. Patching and repair work can be started in the morning and opened to traffic before dark, when this high speed cement is used.

Patch filled before screeding.

Patch ready for finishing.

Patching the Lincoln Highway in Iowa in the morning with Marquette High Early Strength Portland Cement, enabling it to be opened to traffic the same day.

Another intersection in Chicago where Marquette High Early Strength Portland Cement answered the problem of making replacements with minimum public inconvenience and danger.

On Municipal Construction

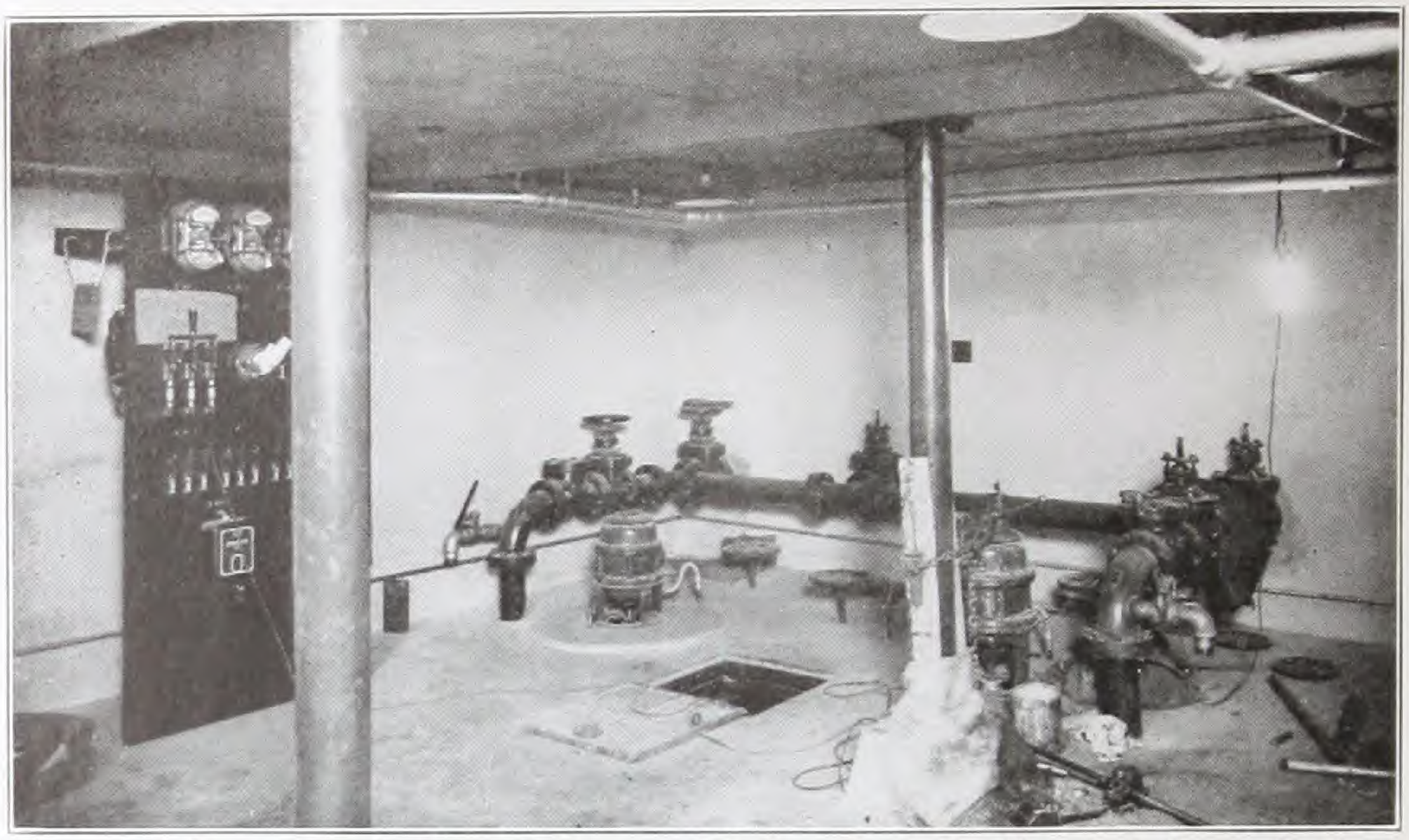
In addition to the foregoing paragraphs regarding the convenience and safety of the motoring public, the Municipal Engineer recognizes the value of the use of a street to abutting property owners, tenants and the general public. In many cases this use will make the time element a matter of such importance that even one day's saving of time in opening a street to traffic, made possible by the use of Marquette High Early Strength Portland Cement, may be worth considerably more than the extra cost involved.

The greater durability of Marquette High Early Strength concrete is a feature which merits attention in all concrete work placed in municipal construction, and it will be found that in many cases an additional expenditure, small as compared with the total cost of a project, will pay dividends over a period of years in terms of longer life and in greater freedom from recurrent expensive repair costs.

This durability is particularly desirable in such work as the construction of filter bed enclosures and other units of sewage disposal plants, sanitary and storm sewers, water filtration and water supply plants and municipal power plants, to mention but a few, and can be obtained most effectively with Marquette High Early Strength concrete, because of its greater workability and density.

Business concerns and the public appreciated the savings in time and money made possible by the use of Marquette High Early Strength Portland Cement in paving heavily traveled Canal Street in Chicago.

At Abingdon, Illinois, Marquette High Early Strength Portland Cement was used in the construction of this sewage disposal plant to assure early completion and to produce impermeable concrete to resist deterioration from sewage.



The pump house for the Sewage Disposal Plant at Batavia, Illinois, is located a few feet from the Fox River and below river level. It had to be watertight, so Marquette High Early Strength Portland Cement was used.

Officials of the Minneapolis-St. Paul Sanitary District of St. Paul, Minnesota, are assured of rapid progress, and dense, durable concrete that will resist the action of sewage by the use of Marquette High Early Strength Portland Cement in this sewer work.

WHAT

Marquette HIGH EARLY STRENGTH Portland Cement means to the . . . . . ARCHITECT

THE advantages in the use of concrete in the design and construction of residences, schools, hospitals, public buildings, office buildings, warehouses and factories, are receiving rapidly increasing recognition in the architectural profession. Its flexibility and adaptability to structural and architectural design, economy in construction, strength, fireproofness and durability offer wide diversification for its practical application to many problems of construction and design.

Each of these desirable features is affected by the use of Marquette High Early Strength concrete. Flexibility and adaptability are increased by its greater plasticity. Economies may be brought about by its superior workability and in the earlier use of the building. Strength is increased at all periods and durability is definitely affected by its impermeability.

The architect who designs in concrete, especially where architectural expression is concerned, is vitally interested, among other things, in exactly reproducing, in

To speed construction and insure watertight concrete for this underground passage between the State Capitol and the State Office Building at St. Paul, Minnesota, Marquette High Early Strength Portland Cement was specified and used.

the finished structure the design he creates. Surfaces of the desired texture must be obtained and they must be free from unsightly pockets or honey-comb. There must be no segregation in the concrete. Lines and corners and fine and delicate architectural details must stand out in sharp relief. The greater plasticity of Marquette High Early Strength concrete materially aids in accomplishing these results.

In addition, the density and impermeability of Marquette High Early Strength concrete are essential qualities for watertight basements, roofs, swimming pools, tanks, industrial floors and platforms.

The Architect is also concerned with the early strength value of Marquette High Early Strength Portland Cement as it results in:

1. Economies in the earlier completion of the structure.
   (a) Their value to the builder or contractor.
   (b) The earlier use by the owner.
2. The shorter time required for protecting and curing.
   (a) Its importance in minimizing the danger of freezing.
3. Economies in construction due to:
   (a) Saving in cost of forms because of earlier removal and re-use.

One other problem frequently confronting the architect is that of minimizing the delay and inconvenience to the owner or occupants in remodelling or making additions to a building, or in placing underpinning. With concrete that can be placed TODAY and used TOMORROW many hours and days of needless delay may be eliminated. In fact, the high speed performance of Marquette High Early Strength Portland Cement may offer opportunities to the Architect to recommend certain changes, which under other circumstances would not be considered practical by the owner, because of his preconceived idea of the delay and inconvenience caused by ordinary concrete construction.

Watertightness and resistance to the elements are assured by the Marquette High Early Strength concrete roof slab on the United States Post Office Building at Dubuque, Iowa.

Striking examples of the adaptability of Marquette High Early Strength concrete to design are shown in these reproductions in concrete in Memorial Park, Memphis, Tennessee.

WHAT

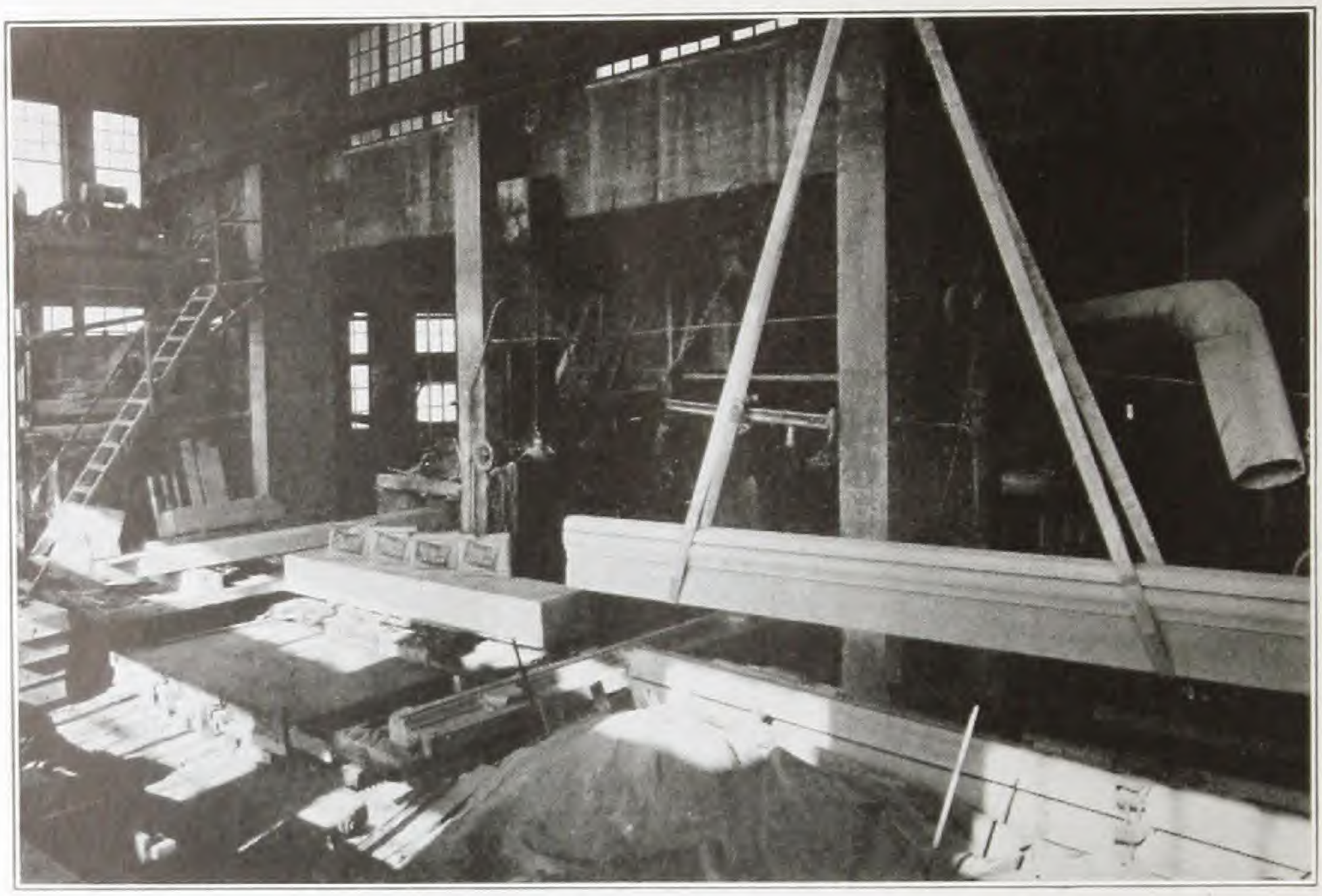
Marquette HIGH EARLY STRENGTH Portland Cement means to the . . . . . CONCRETE PRODUCTS MANUFACTURER

AS in almost any other business, the manufacturer of Concrete Products has to compete both with other products used for a similar purpose and with other manufacturers making the same kind of products. To meet such competition successfully demands that within certain limitations he produce the highest quality product at the lowest possible cost. He must then constantly balance production, selling, and other overhead costs against quality. If he can produce as good a product at less cost this means extra profits because of production economies. If he can make a better product without increasing production costs he will make extra profits because of increased sales of such better products. Surely then if he can *increase* quality and at the same time *decrease* cost he profits from both the lower cost and from the increased sales of superior products.

The use of Marquette High Early Strength Portland Cement offers this possibility to the manufacturer of all kinds of concrete products, be they blocks, precast joists, tile, pipe, precast stone, architectural details, imitation marble, burial vaults, culverts, posts, piles or other special products.

The characteristics of Marquette High Early Strength Portland Cement help to reduce costs in several different ways.

First, its high early strength, allowing quicker handling and use of products, makes it possible to keep a smaller inventory of finished products on hand. This smaller inventory requires less space for storage, and space and buildings cost money whether rented or owned. Less inventory also means less money invested in the labor and materials which go into the finished products. These then tend to decrease the cost of doing business. But as to whether the decrease will be sufficient to



This products plant at Waterloo, Iowa, uses Marquette **High Early Strength Portland Cement** in manufacturing pre-cast stone which successfully and profitably competes with Bedford Stone.

more than offset the additional cost of Marquette High Early Strength Portland Cement will depend upon individual plant conditions and operating methods. That this is possible has been proven by others, and each products manufacturer might well experiment and definitely prove to his own satisfaction the amount of saving that may result.

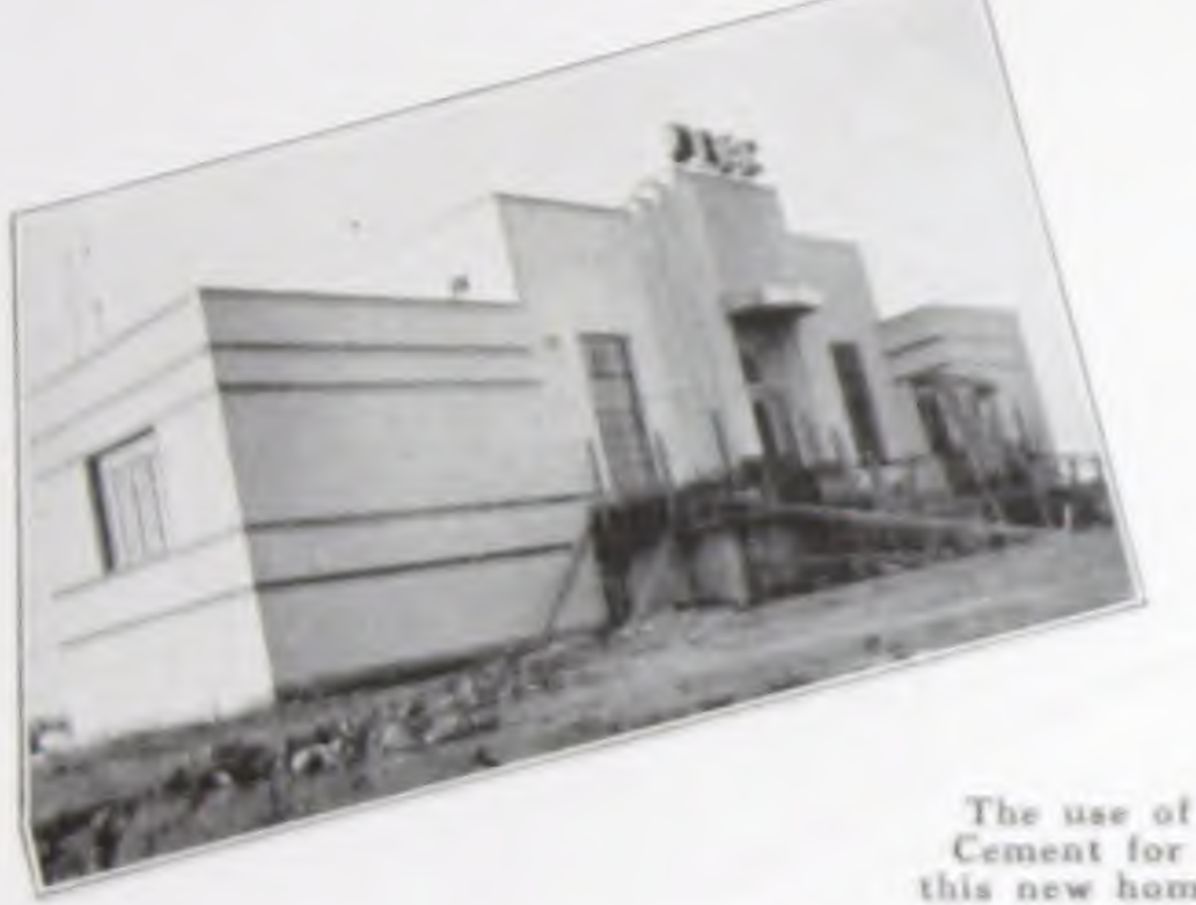
The second way in which Marquette High Early Strength Portland Cement saves money is in its help in building up sales, by being able to produce and offer superior products for sale. If a manufacturer can build up a demand for *his* products in preference to competitive products, because of their superior quality, it stands to reason that he will sell more of them with no more selling effort. This means greater volume and more rapid turnover with a proportionately smaller overhead and sales expense per unit. Concrete products made with Marquette High Early Strength Portland Cement are denser than similar products made with regular cement. This impermeability means that they will better withstand severe exposure conditions, be more nearly waterproof, and better resist all deteriorating influences, all of which are convincing selling arguments.

One other advantage is in filling emergency orders. Concrete products can be quickly made and delivered with the least possible delay when made with Marquette High Early Strength Portland Cement.

Production is speeded and head-stones that will last for eternity are manufactured with Marquette High Early Strength Portland Cement at Madisonville, Kentucky.

Water Meter boxes made by the Kentucky Utilities Company, Fulton, Kentucky, are constructed with Marquette High Early Strength Portland Cement to reduce costs and assure resistance to exposure.

These burial Vaults built at Janesville, Wisconsin, are watertight and the extreme density of Marquette High Early Strength concrete makes it possible to handle them shortly after they are made.



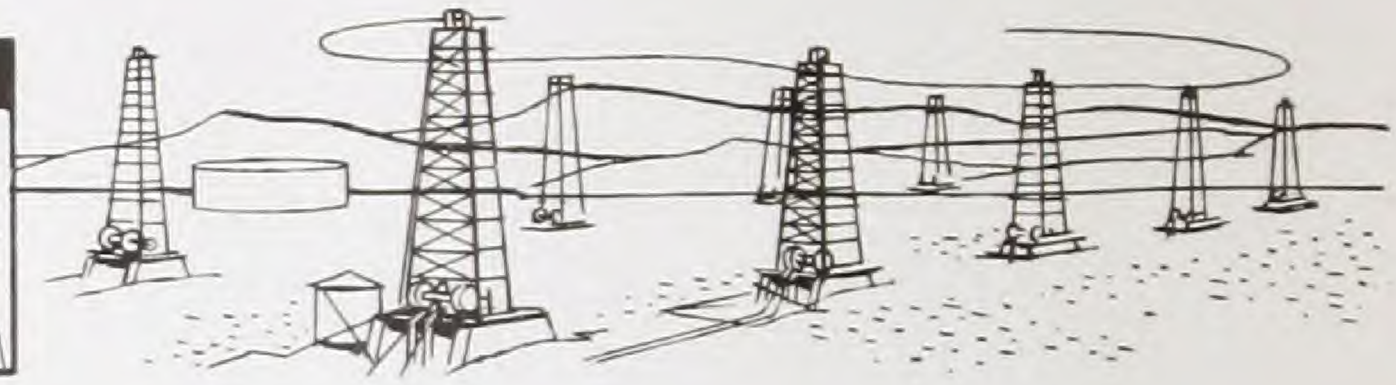
The use of Marquette High Early Strength Portland Cement for studding and joists speeded construction of this new home for Radio Station WREC at Memphis, Tenn.

Pre-cast trim for this garage building and fire station in Waterloo, Iowa, were manufactured and delivered on short notice because Marquette High Early Strength Portland Cement was used.

Marquette High Early Strength Portland Cement was used in the construction of the pre-cast joists and ceiling slabs in remodelling the Court House at Vandalia, Illinois.

WHAT

Marquette HIGH EARLY STRENGTH Portland Cement means in the . . . . . OIL FIELD



FROM the drilling of oil wells to the construction of Service Stations, cement and concrete are used extensively in converting crude oil in the ground to gasoline in the motor car. In all of these operations speed is highly important from a money-saving standpoint. Wells have to be drilled and capped as quickly as possible, just as customers have to be served with the least possible delay and inconvenience at the Filling Station.

Aside from the earlier use obtained with Marquette High Early Strength Portland Cement, its greater plasticity with a given amount of water, as compared to regular portland cement, is a decided asset in oil well drilling. Its physical and chemical properties also produce an impermeable concrete of maximum density, so advantageous for all the uses of concrete in the petroleum industry.

An oil well is a producing plant; and the cement used in its construction is a vital factor in the protection of the source of supply, in the efficiency of the producing well and in the permanency of the subsurface structure. Time is a most important element in the drilling or repair of a well as an extra few days of shut-down, with the well delayed or off-production, may make the cementing operation a costly procedure.

Marquette High Early Strength Portland Cement helps to eliminate these delays in oil well operation by providing a grout or slurry that will attain its strength days ahead of regular portland cement, and yet not have an accelerated initial set, so frequently encountered by the use of re-agents. Marquette High Early Strength Portland Cement during the first stages of hardening acts about the same as regular portland cement.

These characteristics of high early strength without accelerated

initial set, greater workability and greater density, are of particular value under such conditions as are described below.

The cementing of casing is one of the most important operations in the drilling and completion of an oil well. This is especially true of the water string which protects the producing zone from migration of water or other fluids from above. With the deep wells now being drilled, the long strings of even Grade D casing closely approach their collapse strength. This cement therefore provides a reinforcement for the pipe as well as secures a water shut-off; and the present trend is to carry the cement up behind the string well beyond the point where a suitable factor of safety is reached.

Every delay during drilling is costly and cement is frequently the means for reducing shut-down time. Subsurface conditions naturally vary but creviced formations which cause lost circulation can frequently be overcome by the proper application of this cement, either with or without other material. Caving is also a source of trouble which can often be overcome by cement. In all such work, the more rapidly the strength of the cement develops—the less will be the time lost.

Cement has long been used as a means of sidetracking and a high early strength and increased plasticity is advantageous in speeding up this operation. Under general conditions, the well is kept as nearly vertical as possible; but since it will sometimes wander off its course, it must be brought back. A cement plug placed at the point where it starts off will sometimes be the quickest and easiest way of bringing the hole back to vertical. In many cases the hole is enlarged at the bottom before being filled with cement.

Redrilling operations—whether in a new hole to be sidetracked or straightened, or in an old hole where a new position in the sand is desired or other corrections have to be made—frequently provide an opportunity for economy by using a high early strength cement plug.

The plugging off of bottom water can often be done by dumping cement in the hole when no pressure is present. With modern equipment, the cement can now be placed under any pressure and the pressure maintained until the cement has hardened. Moreover, it is a growing custom to cement behind as well as inside the liner if such pipe is left in the hole. This insures a complete shutoff of water from below and is especially necessary in plugging back operations where the cement plug is carried up to near the bottom of an upper productive zone.

There is an increased use of cement for repair work since special equipment provides a means of placing the cement and keeping it where it will be effective. Intermediate water sands are frequently shut off by putting the cement behind the liner only at the place where

The owner of this Service Station in Dubuque, Iowa, was determined to hold loss of sales volume to a minimum when concrete driveways were installed. Within 24-Hours after Marquette High Early Strength concrete was placed, the station was doing "business as usual."

the water shows up, and thus protecting the oil sands above and below.

The shutting-in of high pressure wells that have gotten out of control has frequently been accomplished with cement. In many cases the entire cellar has been filled with concrete. Present practices probably prevent such emergency measures since the first string of casing is securely cemented and subsequent strings tied in with it by landing heads. Also, it is becoming a universal practice to cement each string as soon as it is landed. With proper high pressure fittings and blow-out preventers a well can always be kept under control; and a string of casing can be cemented even if the hole penetrates a high pressure sand before the pipe is run.

For all of these operations the amount of water used in making the cement slurry for oil well use naturally has considerable influence on the strength of the grout. The lower the amount of water the denser will be the slurry: and the thickest slurry that can be handled will give the best job. In oil field practice, however, the conditions of a particular job to be performed may necessitate different water-cement ratios. The average is about 5 gallons of water per sack of cement or a water-cement ratio of about 44 per cent, but the fact that Marquette High Early Strength Portland Cement does not require as much water to secure a given consistency, as with regular portland cement, enables it to attain greater density with equal plasticity using less water, or equal density and greater flowability with a similar water-cement ratio.

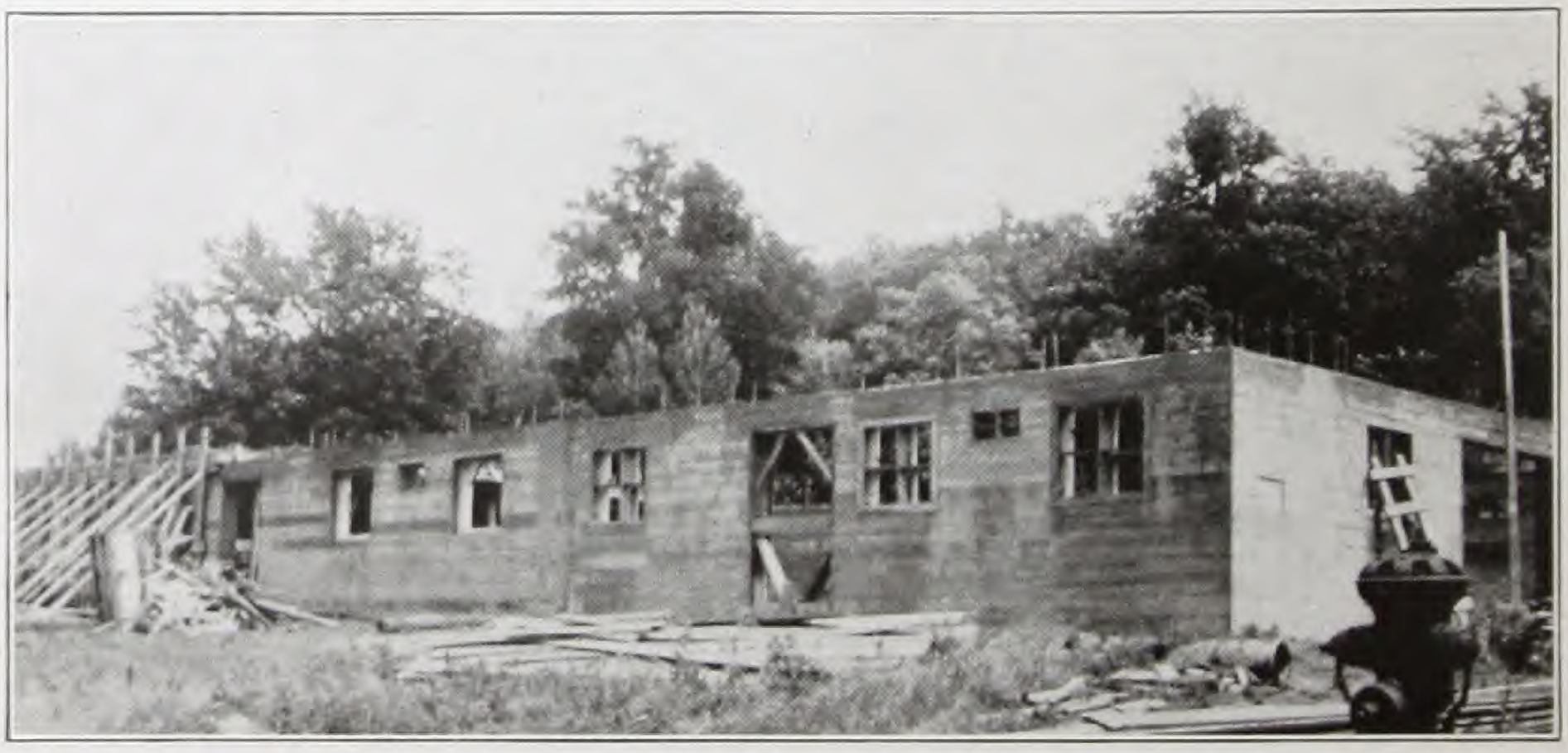
In such construction as machinery and engine foundations, derrick footings and storage tanks in the field, to the building of floors, driveways, greasing pits, foundations, walls or stucco for the Filling Station the early strength and other qualities of Marquette High Early Strength Portland Cement are almost indispensable to the Oil Industry.

WHAT

Marquette HIGH EARLY STRENGTH Portland Cement means to the . . . . . FARMER

BECAUSE of its permanence and adaptability, concrete has become the outstanding building and repair material for farm structures. No matter where it is used — for a foundation wall, for a barn floor or barnyard pavement, for fence posts, or for a watering tank—concrete is readily made and once placed is there to stay. Through the snow and ice of winter, the rain and burning sun of summer, concrete lives on indefinitely without decay, rot or warping. Neither termites nor rats can eat it. Surely concrete is the ideal material for building and repairing on the farm.

But because of the seasonal aspect of farming and nature's urgent demands on the farmer's time, whatever building or improvements he undertakes must be done in what is lightly termed as his "spare"



Marquette High Early Strength concrete was used to speed construction and assure dense durable concrete to resist action of ammonia salts in this cow barn at Taycheedah, Wisconsin.

The action of silage acid is successfully resisted with Marquette High Early Strength Portland Cement in these silos near Batavia, Illinois, Lomira and Mequon, Wisconsin.

time. This is either during the winter or during short spells of inclement weather. If he is building of concrete, which is so applicable for most farm improvements, Marquette High Early Strength Portland Cement will be found useful under both of the above conditions.

In the winter time its high early strength reduces the hazard of freezing, because if the temperature has not dropped below 30 degrees within 24 to 48 hours after the concrete was placed (assuming the temperature to have been above freezing when placed), a further drop in temperature will not affect it, as it has hardened sufficiently or developed enough strength within that time to withstand further freezing weather. This would not be the case with regular portland cement concrete, which might be frozen and perhaps ruined any time from a week to 10 days after being placed.

When weather conditions prevent or interrupt the regular farm work, and because of this interruption some form of concrete improvement is started, it is usually a decided advantage for the farmer to complete it as rapidly as possible before it is necessary for him to work elsewhere. Under such conditions it will be a distinct advantage to remove the forms and continue with the work the day after the concrete is placed, instead of waiting for a week or more for ordinary concrete to cure and harden. The use of Marquette High Early Strength Portland Cement, under such conditions, will make this possible.

Ordinary concrete, if placed in real hot, dry weather, must be kept moist and covered from 10 to 14 days, during the curing period which usually means wetting it at least once a day. This is a nuisance in busy times. With Marquette High Early Strength concrete this curing and protection may be discontinued the second day after the concrete is placed.

The farmer will also find its greater workability will make it easier to handle in the forms, requiring less work; and the fact that it makes a denser and more watertight concrete will be of practical advantage in many of the uses of concrete on the farm.

Preserving silos with an inside coating of Marquette High Early Strength Portland Cement mortar.

WHAT

Marquette HIGH EARLY STRENGTH Portland Cement

means to the . . . HOME OWNER

IT is customary in building a home to accept the architect's judgment and experience in all matters pertaining to architectural and structural design, selection of materials and other technical questions involved. This is proper and fitting because that is the architect's function. However, you might reasonably ask him why he recommends a particular design or material, or ask his opinion as to the merits of some other method or material.

In dealing with your architect, you have no doubt told him in advance about the size and style of the house you want, and have also stipulated certain features which you want embodied in your home. Unless you have made a study of the subject, these preferences will probably be limited to the appearance, arrangement, and comfort of your home. In addition to these features, you should also be equally concerned with its permanence, its serviceability, and its saleability. You want a roof that will not leak, walls that will not crack, and a basement that is watertight and easily kept clean. You want a foundation that will stand against time and that will not be attacked by termites. (Termites are constantly destroying wooden foundations of homes and buildings, and their destructive activities are spreading over wider areas every year.) You should consider the advantages of a first floor of concrete to make a fireproof basement, as most residential fires start in the basement.

Perhaps you are building one of the modern all concrete homes which are becoming increasingly popular, but regardless of the amount of concrete in your home, you will want all the concrete to be durable and watertight.

At practically no additional cost, because of economies resulting from its use, you can secure the advantages of the superior qualities of Marquette High Early Strength Portland Cement, particularly for all

Marquette High Early Strength Portland Cement was used in the stucco work on this home in Libertyville, Illinois, because its extreme plasticity and workability assured the highest grade job.

exposed exterior concrete work and foundations as well. Your architect or builder knows and will confirm to you the worth of denser, more durable and watertight concrete. All these qualities may be obtained most effectively with this cement.

Another advantage, if you are in a hurry to occupy your home, is the saving in time accomplished by using Marquette High Early Strength concrete, which attains its strength within twenty-four hours after it is placed, under normal weather conditions, instead of the week or more required for regular concrete to harden.

If your home is built in cold weather, ordinary concrete is apt to freeze at any time within fourteen days after placing. This necessitates either protection against freezing for this period, or incurring the risk of getting an unstable concrete job. With the use of Marquette High Early Strength Portland Cement, which causes the concrete to harden within 24-Hours, beyond the possiblity of damage from freezing, this risk is greatly minimized and the cost of protection from freezing is also materially reduced.

For concrete improvements around the home, whether they be for utilitarian purposes such as walls, steps, drives, walks and porch floors, or for decoration such as sun dials, bird baths, pools and arbors, Marquette High Early Strength Portland Cement will make it easier and more certain to get a first class job and one that will endure.

The watertight, impermeable Marquette High Early Strength concrete floor and walls in this home basement recreation room in Waukegan, Illinois, assure the owner that his investment in knotty pine covering on the concrete walls and his possessions are safe from damage by water or dampness.

The VALUE of Marquette HIGH EARLY STRENGTH Portland Cement for COLD WEATHER CONSTRUCTION

THERE are many reasons why it is desirable and valuable to start or continue concrete construction in cold weather. A few such reasons follow:

The owner avoids delay in getting into a new structure which was started in late fall or early winter. He is given the advantage of the earliest use of additions, or remodeling jobs, or forced rebuilding after a fire. These savings of time mean money savings to owners.

Cold weather construction work is an advantage to labor because it affords steady all year round employment.

The contractor gains by winter construction because it enables him to maintain a permanent organization with a consequent reduction of overhead expense. This also applies, to some extent, to the architect and engineer.

Every day of delay in the completion of a needed improvement means inconvenience and perhaps hazard to the general public, especially in winter. Streets and sidewalks and other improvements can be constructed or repaired to the advantage of the public in cold weather. Park improvements, pools, etc., also can be built in cold weather, thus assuring use in the spring and summer.

Winter construction with concrete can be just as satisfactory as that placed in any other season, and the quality of the concrete is just as good. The old time inhibition about concrete work in cold weather was largely a matter of habit and custom and not one of climatic necessity. Today much of such work is done in winter as a matter of course, and the amount of this work increases every year as the advantages and the relative ease and economy of doing it become more generally understood.

A simple statement of the procedure necessary in cold weather construction is that temperatures of 50 to 70° F. must be maintained

Ready mixed Marquette High Early Strength concrete being delivered in Milwaukee for work in freezing weather. Its high early strength reduced the hazard of freezing and the cost of protecting.

in the concrete mixture, both before and after placing, until it has attained a degree of hardness that will prevent injury from freezing. Obviously then, if a cement is used in the concrete mixture which will bring about this necessary hardness in approximately 1/7th of the time when regular cement is used, the period of time during which protection from freezing is needed is reduced by just that much.

This results in substantial savings in cost of heating and protection. Marquette High Early Strength Portland Cement will accomplish this saving of time and money. The effective fineness to which it is ground, together with its high grade basic properties, cause it to combine with the water in the concrete mix much more rapidly and completely than is the case with regular cement, hence its high early strength.

For best results in cold weather construction with Marquette High Early Strength Portland Cement, the water and aggregates should be heated so that the temperature of the concrete when placed will not be less than 70° F. nor more than 100° F. During the curing period the concrete should be protected and the temperature maintained approximately at 70° F. but under no circumstances allowed to drop below 50° F. Under these conditions the time required for Marquette High Early Strength concrete to pass the danger of freezing is reduced to a minimum and the total cost of concreting is brought very closely in line with the cost when placed in warmer weather. Except under extreme and very unusual conditions Marquette High Early Strength concrete will pass this danger of freezing in 24 hours or less, provided, of course, temperature of the concrete mixture is maintained at approximately 70° F. both before and after placing.

In zero weather this six-foot conduit was built by the Water Department of St. Paul, Minnesota. Such work demanded concrete of highest early strength and greatest density. Marquette High Early Strength Portland Cement was used.

The entire substructure of the Roosevelt Junior High School Auditorium at Fond du Lac, Wisconsin, was placed in swampy sub-soil in winter. Marquette High Early Strength Portland Cement was used to make watertight concrete and to save money in protecting it from freezing.

DESIGN of Marquette HIGH EARLY STRENGTH Concrete Mixtures and Recommended Construction Practices

VAST research, both in the laboratory and in the field, has established certain facts about concrete mixtures from which has developed the following Water-Cement Ratio Law:

"For plastic mixtures, using sound and clean aggregates, the strength and other desirable properties of concrete under given job conditions are governed by the net amount of mixing water per sack of cement."

Previously this law was applied only to compressive strength but later developments have proved that it also controls density, resistance to wear and the bond between concrete and steel.

The law will be more readily understood if one thinks of cement and water as a paste which, upon hardening, binds the aggregate particles together to form a solid mass. The more water added to the paste the more diluted it becomes, therefore weaker and less watertight Since the strength and density of the concrete are directly dependent upon the strength and density of the paste, it will be seen that to dilute the paste is to reduce the strength and durability of the concrete.

It follows then that the procedure in the design of a High Early Strength concrete mixture involves:

1. The selection of the proper Water-Cement Ratio which will give the desired strength and durability for any particular age.
2. Determining the most suitable and economical combination of aggregates which will give the desired workability with this Water-Cement Ratio.

A High Early Strength Concrete Mixture designed in accordance with the foregoing will provide:

1. Necessary strength,
2. Durability to resist the actions of the elements,
3. Workability to permit proper placing,
4. The most economical use of available materials, and will establish a proper balance between these four essentials.

TABLE 1

Age of Concrete	Gallons of Mixing Water per Sack of Cement				
	4 gals.	5 gals.	6 gals.	7 gals.	8 gals.
1 Day	3600 lbs.	2700 lbs.	2000 lbs.	1400 lbs.	900 lbs.
3 Days	5500 lbs.	4200 lbs.	3400 lbs.	2600 lbs.	2000 lbs.
7 Days	6600 lbs.	5300 lbs.	4400 lbs.	3800 lbs.	3200 lbs.
28 Days	7500 lbs.	6300 lbs.	5500 lbs.	4800 lbs.	4100 lbs.

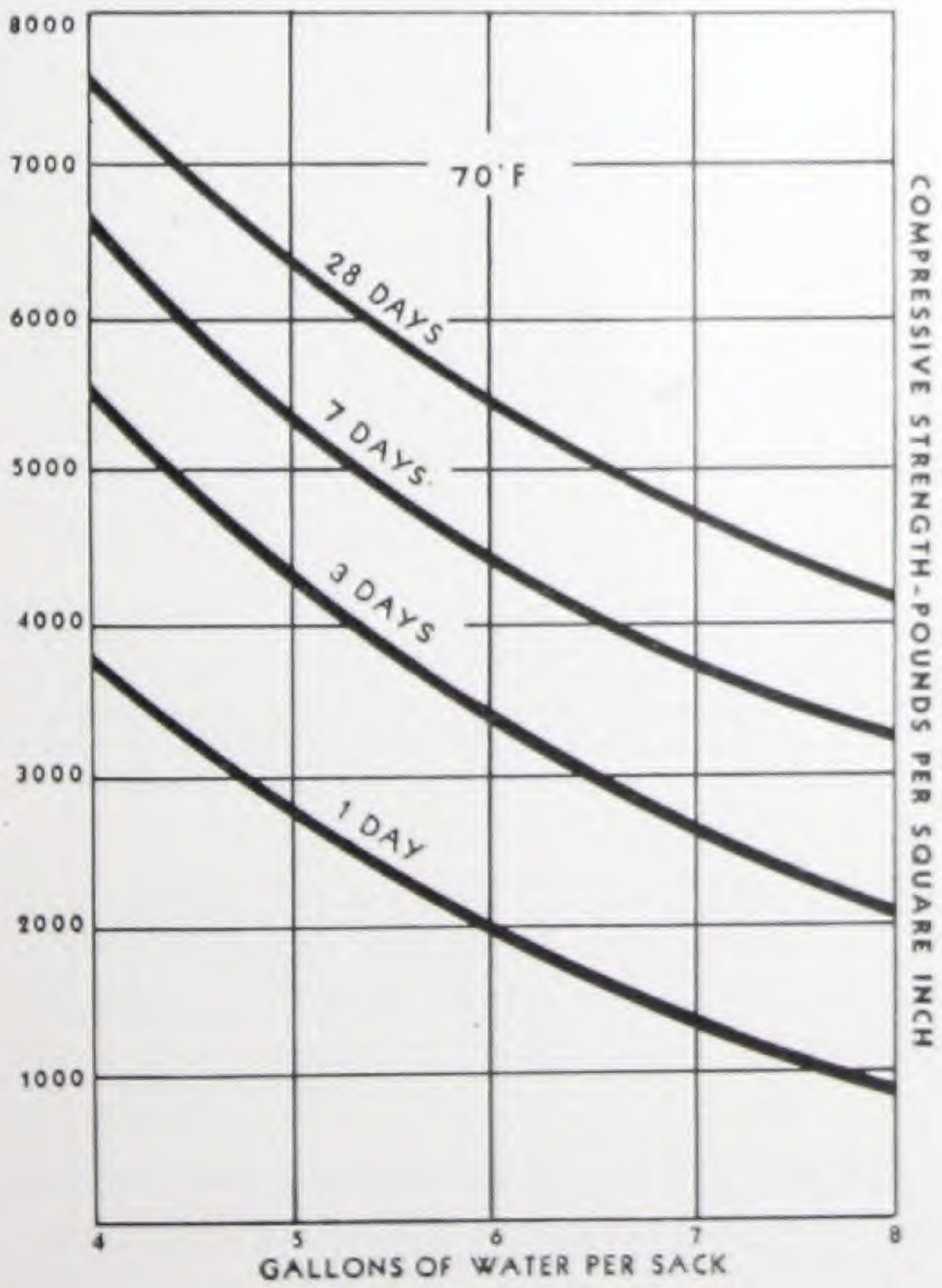


TABLE and GRAPH showing Compressive Strengths of machine mixed Marquette High Early Strength concrete in pounds per square inch at different ages with various water-cement ratios. (U. S. gallons of water per sack of cement.)

TABLE 2

RECOMMENDED WATER-CEMENT RATIOS FOR MARQUETTE HIGH EARLY STRENGTH CONCRETE TO MEET DIFFERENT DEGREES OF EXPOSURE

Exposure \ Class of structure	Water-cement ratio, U. S. gal. per sack*		
	Reinforced piles, thin walls, light structural members, exterior columns and beams in buildings	Reinforced reservoirs, water tanks, pressure pipes, sewers, canal linings, dams of thin sections	Heavy walls, piers, foundations, dams of heavy sections
Extreme: 1. In severe climates like in northern U. S., exposure to alternate wetting and drying, freezing and thawing, as at the water line in hydraulic structures. 2. Exposure to sea and strong sulphate waters in both severe and moderate climates.	5½	5½	6
Severe: 3. In severe climates like in northern U. S., exposure to rain and snow, and freezing and thawing, but not continuously in contact with water. 4. In moderate climates like southern U. S., exposure to alternate wetting and drying, as at water line in hydraulic structures.	6	6	6¾
Moderate: 5. In climates like southern U. S., exposure to ordinary weather, but not continuously in contact with water. 6. Concrete completely submerged, but protected from freezing.	6¾	6	7½
Protected: 7. Ordinary inclosed structural members; concrete below the ground and not subject to action of corrosive groundwaters or freezing and thawing.	7½	6	8¼

*Surface water or moisture carried by the aggregate must be included as part of the mixing water.

To obtain superior results with the use of Marquette High Early Strength Portland Cement the following recommendations are made as a guide in the selection of materials, design of concrete mixtures and construction practices.

General

Any structure should be designed and all work carried out under the supervision of a competent architect or engineer.

Cement

Shall be Marquette High Early Strength Portland Cement.

Aggregates

Bank or pitrun aggregates shall not be used.

Fine Aggregate

Shall be sand consisting of hard, strong and durable particles, well graded from fine to coarse within the following limits:

Passing a $\frac{3}{8}$ inch screen	100%
Passing a No. 4 Sieve	85-100%
Passing a 16 mesh sieve	45-80%
Passing a 50 mesh sieve	2-30%
Passing a 100 mesh sieve	0-5%

It shall be free from injurious amounts of organic impurities and shall not contain harmful amounts of clay, shale, coal or other deleterious matter.

Coarse Aggregate

Shall be crushed stone, gravel or other approved material consisting of hard, strong and durable particles, free from adherent coatings and injurious amounts of clay, coal and other deleterious substances.

It shall be well graded from fine to coarse within the following limits:

Designated Size	Percentages retained on Laboratory Sieves Having Square Openings						
	2″	1½″	1″	¾″	½″	⅜″	No. 4
2″ to #4	0–5	.....	30–65	.....	70–90	.....	95–100
1½″ to #4	....	0–5	.....	30–65	.....	70–90	95–100
1″ to #4	....	.....	0–10	.....	40–75	.....	90–100
¾″ to #4	....	.....	.....	0–10	.....	45–80	90–100
2″ to 1″	0–10	30–65	85–100	.....	.....	.....	.....
1½″ to ¾″	...	0–10	45–80	85–100	.....	.....	.....

Mixing Water

Shall be from an approved source and as used shall be clean and fit for drinking. It shall be as close as possible to 70° F. and in no case below 50°.

Proportioning

(a) Select the proper water-cement ratio for the strength required at any particular age. (See Table 1)

(b) Select the proper water-cement ratio for the exposure conditions. (See Table 2)

(c) Use the lower of the above two water-cement ratios.

(d) Trial batches are recommended as the best method to arrive at the desired mix. Make up a few trial batches of different proportions of the fine and coarse aggregate with the selected water-cement ratio until the desired workability is obtained and use that mix which weighs the most per cubic foot.

TABLE 3

QUANTITIES BY VOLUME OF MATERIALS REQUIRED FOR MARQUETTE HIGH EARLY STRENGTH CONCRETE AGGREGATES MEASURED BY DAMP LOOSE VOLUME

WITH ONE-INCH COARSE AGGREGATE

Consistency	Materials Per Sack of Cement							Materials Required For One Cubic Yard of Concrete							
	With Gravel			With Crushed Stone				With Gravel				With Crushed Stone			
	Sand Cu. Ft.	Gravel Cu. Ft.	Water* Gal.	Sand Cu. Ft.	Stone Cu. Ft.	Water* Gal.	Cement Sacks	Sand Cu. Ft.	Sand Cu. Yd.	Gravel Cu. Ft.	Gravel Cu. Yd.	Sand Cu. Ft.	Sand Cu. Yd.	Stone Cu. Ft.	Stone Cu. Yd
Total Mixing Water 5 Gallons Per Sack of Cement															
Stiff	2.1	3.1	3.9	2.5	2.8	3.7	6.6	14.1	.52	20.4	.76	16.6	.62	18.2	.67
Medium	1.9	2.7	4.0	2.2	2.4	3.8	7.2	13.6	.50	19.7	.73	16.0	.59	17.6	.65
Wet	1.7	2.4	4.2	2.0	2.2	3.9	7.8	13.1	.49	19.0	.70	15.5	.57	16.9	.63
Total Mixing Water 6 Gallons Per Sack of Cement															
Stiff	2.8	3.6	4.6	3.3	3.2	4.2	5.5	15.6	.58	20.0	.74	18.3	.68	17.7	.66
Medium	2.5	3.2	4.7	3.0	2.9	4.4	6.0	15.1	.56	19.4	.72	17.7	.66	17.2	.64
Wet	2.3	2.9	4.8	2.6	2.6	4.6	6.5	14.6	.54	18.8	.70	17.2	.64	16.6	.62
Total Mixing Water 7½ Gallons Per Sack of Cement															
Stiff	3.9	4.5	5.4	4.6	3.9	5.1	4.4	17.2	.64	19.6	.73	20.1	.74	17.2	.64
Medium	3.5	4.0	5.6	4.1	3.5	5.3	4.8	16.8	.62	19.0	.70	19.5	.72	16.7	.62
Wet	3.1	3.5	5.8	3.6	3.1	5.5	5.2	16.3	.60	18.3	.68	18.9	.70	16.2	.60

WITH TWO-INCH COARSE AGGREGATE

Total Mixing Water 5 Gallons Per Sack of Cement															
Stiff	2.2	3.7	3.8	2.6	3.4	3.7	6.0	13.3	.49	22.2	.82	15.7	.58	20.2	.75
Medium	2.0	3.2	4.0	2.3	3.0	3.8	6.6	13.0	.48	21.4	.79	15.2	.56	19.4	.72
Wet	1.7	2.9	4.2	2.0	2.6	3.9	7.2	12.5	.46	20.6	.76	14.6	.54	18.8	.70
Total Mixing Water 6 Gallons Per Sack of Cement															
Stiff	3.0	4.3	4.5	3.4	4.0	4.2	5.0	14.9	.55	21.6	.80	17.2	.64	19.6	.73
Medium	2.6	3.8	4.7	3.0	3.5	4.4	5.5	14.4	.53	21.0	.78	16.8	.62	19.0	.70
Wet	2.3	3.4	4.8	2.7	3.1	4.6	6.0	13.9	.52	20.4	.76	16.3	.60	18.4	.68
Total Mixing Water 7½ Gallons Per Sack of Cement															
Stiff	4.1	5.3	5.2	4.7	4.8	5.0	4.0	16.5	.61	21.2	.79	19.0	.70	19.1	.71
Medium	3.6	4.6	5.6	4.2	4.2	5.2	4.4	16.0	.59	20.6	.76	18.4	.68	18.6	.69
Wet	3.2	4.2	5.8	3.7	3.8	5.5	4.8	15.6	.58	20.0	.74	17.9	.66	18.0	.67

*Corrected for free moisture carried by sand.

This table is based on the following assumptions: Absorption of aggregate 1% by weight; free moisture in sand 5% by weight; coarse aggregate surface dry; weight of sand 89 lb. per cu. ft. measured damp, loose; weight of coarse aggregage 99 lb. per cu. ft. measured loose.

TABLE 4

QUANTITIES BY WEIGHT OF MATERIALS REQUIRED FOR MARQUETTE HIGH EARLY STRENGTH CONCRETE

WITH ONE-INCH COARSE AGGREGATE

Consistency	Materials Per Sack of Cement						Materials Required Per Cubic Yard of Concrete				
	With Gravel			With Crushed Stone				With Gravel		With Stone	
	Sand Lbs.	Gravel Lbs.	Water* Gals.	Sand Lbs.	Stone Lbs.	Water* Gals.	Cement Sacks	Sand Lbs.	Gravel Lbs.	Sand Lbs.	Stone Lbs.
5 Gallons Total Water Per Sack of Cement											
Stiff	189	307	3.9	225	273	3.7	6.6	1250	2025	1480	1805
Medium	167	271	4.0	199	241	3.8	7.2	1200	1950	1430	1740
Wet	149	241	4.2	177	215	3.9	7.8	1160	1875	1380	1670
6 Gallons Total Water Per Sack of Cement											
Stiff	252	360	4.6	297	318	4.2	5.5	1390	1980	1630	1750
Medium	224	320	4.7	263	283	4.4	6.0	1350	1920	1580	1700
Wet	201	286	4.8	236	253	4.6	6.5	1310	1860	1530	1640
7½ Gallons Total Water Per Sack of Cement											
Stiff	350	441	5.4	406	386	5.1	4.4	1540	1940	1790	1700
Medium	312	392	5.6	362	344	5.3	4.8	1500	1880	1740	1650
Wet	278	351	5.8	323	307	5.5	5.2	1450	1820	1680	1600

WITH TWO-INCH COARSE AGGREGATE

5 Gallons Total Water Per Sack of Cement											
Stiff	199	366	3.8	234	333	3.7	6.0	1190	2200	1400	2000
Medium	175	321	4.0	205	292	3.8	6.6	1160	2115	1350	1920
Wet	155	284	4.2	181	258	3.9	7.2	1120	2040	1300	1860
6 Gallons Total Water Per Sack of Cement											
Stiff	266	428	4.5	307	398	4.2	5.0	1330	2140	1540	1940
Medium	234	378	4.7	272	342	4.4	5.5	1290	2080	1500	1880
Wet	208	336	4.8	241	304	4.6	6.0	1250	2020	1450	1820
7½ Gallons Total Water Per Sack of Cement											
Stiff	369	525	5.2	424	473	5.0	4.0	1470	2100	1690	1890
Medium	325	464	5.6	373	418	5.2	4.4	1430	2040	1650	1840
Wet	290	413	5.8	332	372	5.5	4.8	1390	1980	1600	1780

*Amount of water to add allowing for moisture in sand.
This table is based on aggregates of 2.65 specific gravity and sand containing 5 per cent moisture by weight. No allowance has been made for waste.

Arbitrary Mixes

For common construction purposes the proportions of cement, fine and coarse aggregate will approximate 1 : 2 : 3. This will contain approximately 6 sacks of cement per cubic yard of concrete and should contain not more than 6 gallons of water per sack of cement.

Mixing

All concrete shall be mixed continuously for 1½ minutes after all materials, including water, are in the mixer drum.

Placing

Concrete shall be placed so that it may be worked into its final position with the least amount of rehandling. At day-to-day construction joints, or when fresh concrete is placed on concrete already hardened, the old surface shall be clean, rough, free from any form of laitance, and wetted. A rich grout of cement and sand shall be brushed into the old surface immediately before the fresh concrete is placed in contact with it.

Curing

All concrete shall be kept moist and protected from drying out too rapidly during the early part of the period in which it is attaining its designed strength. The temperature shall be kept as close as possible to 70° F. and in no case allowed to go below 50° F.

Temperature

The temperature of the water and aggregates shall be such that the temperature of the concrete when placed shall be as close as possible to 70° F. and shall in no case be below 50° F.

WEARING OR TOP COURSE FOR FLOORS

Proportions—1:2½ (using sand) or 1:1:1½ to 1:1:2 (using coarse aggregate).

Thickness—1 inch minimum.

Grading of Aggregates—Clean, sharp sand passing 100% through a ¼ inch screen with not more than 20% through a No. 50 screen, and not more than 3% through a No. 100 screen. Coarse aggregate passing ⅜ inch screen.

Consistency—The mortar shall be the driest possible to work with a sawing motion of the strikeboard. This will require about 3½ gallons of water per sack of Marquette High Early Strength Portland Cement.

Mixing—Not less than 2 minutes after materials are in mixer drum.

Placing—This course shall be placed immediately after mixing and deposited on the base concrete before it has appreciably hardened, being brought to the established grade with a strikeboard.

Although specifications did not require its use, the contractor bought Marquette High Early Strength Portland Cement and saved time and money on this paving job at Mt. Morris, Illinois.

Finishing—In about 2 hours thereafter it shall be worked with a wood float thoroughly compacting it and providing a surface free from depressions or irregularities. This time shall elapse to permit excess water to evaporate from the surface and enable the concrete to partially harden, preventing drawing to the top the finer particles of cement, sand and excess water from the body of the concrete. Dry cement or a mixture of dry cement and sand *must not* be sprinkled on the surface to absorb moisture or hasten the hardening. The finisher must wait until any particular section is ready to trowel and then complete the steel troweling in one continuous operation as the successive areas of floor become ready. Avoid excessive troweling.

NEW TOP COURSE ON OLD BASE SLAB

Preparation of Slab—The surface of the old base slab shall be thoroughly roughened by picking or other means and cleaned of all dirt and debris. Scrub surface with a 20% solution of muriatic acid and then remove all traces of acid with a stream of water from a hose. The slab shall be thoroughly moist but free from film or pools of water. Next Marquette High Early Strength Portland Cement shall be dusted onto and thoroughly brushed into the old prepared surface immediately before the wearing or topping course is applied insuring a thorough bond. This shall also apply in any case where it has not been possible to place the wearing course before the base course has hardened.

Curing of Floor Surface—Concrete shall be kept moist and not permitted to dry out for 24 hours after placing.

STUCCO

Proper flashing should be used at every place where it would be possible for water to get behind the stucco. In general, the construction shall protect the surface against excessive concentrated water flow, horizontal projections being provided with overhanging drips and watertight joints.

Reinforcement shall consist of expanded metal or wire fabric, with openings large enough to permit complete embedding of the reinforcing under conditions of actual practice.

Mortar for scratch coat shall be of 1:2½ proportions, and for second coat 1:3 proportions. The surface of each coat shall be cross-scratched and cured properly for as long a time as possible before the application of the following coat. This is to seal shrinkage cracks which sometimes occur. The finish coat shall provide only color and texture to the surface.

Marquette High Early Strength Portland Cement shall be used and finished and combined with mineral pigments for coloring, the same as regular portland cement.

Further and more detailed information on the use and advantages of Marquette High Early Strength Portland Cement under any unusual conditions, or in connection with the design of High Early Strength Concrete mixtures, selection of materials, etc., may be obtained by submitting the particular problem to the Service Department.

Address

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HOW'S THAT FOR HIGH EARLY STRENGTH!